THE

ELECTRICAL REVIEW.

VOL. LXI. DECEMBER 27, 1907. No. 1,570.

ELECTRICAL REVIEW.

Vol. LXI.] CONTENTS: December 27, 1907. [No. 1,570.

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THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

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OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGENKAY, LONDON." Code, A B C.

Telephone Nos. Holborn 963; Central 4425 (Editorial only).

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THE
UNIVERSAL ELECTRICAL DIRECTORY
(J. A. BERLY'S).

1908 EDITION

NOW IN PREPARATION.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

ANGLO-RUSSIAN ENGINEERING TRADE.

THE problem of securing trade with Russia is one which, although it has interested British engineers for many years, is complicated by a number of causes which need to be carefully analysed, in order that their effects may be properly understood.

In the first place, one finds a country whose internal engineering resources are at the present time totally inadequate to meet the demand for engineering plant within its own borders, while at the same time there is a heavy protective tariff against the importation of engineering goods from Britain and from other parts of the Continent. In spite of this, the imports into Russia are steadily on the increase, as will be seen from the fact that in 1902 8,602,000 roubles' worth of machinery, instruments, agricultural implements, and parts thereof, were sent from Britain to Russia; while the figure for 1906 was 11,833,000. Continental trade may be represented by Germany, whose imports of machinery, &c., in 1902 were valued at 26,575,000 roubles; and in 1906, 286,538,000.

Another factor which renders Russian trade peculiar is the difference between British and Russian systems of payment. Mr. Boris Brandherdler, writing in the *Chamber of Commerce Journal* for October, points out that: "As is well known, England, as a purely commercial country, is largely a cash trader, while Russia, as an essentially agricultural country, where everything depends upon the realisation of harvest, is compelled to obtain long credit." This has the effect of restricting the general trading of Britain direct with Russian customers, and puts two or three Russian firms, who are well enough placed to maintain a cash system, in the enviable position of dictating to a large extent the sale price of British goods to a Russian customer. The enormous power of the middlemen in this case involves such a throttling effect upon British trade in Russia that considerable attention should be devoted to this point, with a view to breaking down the semi-monopoly.

British goods are so highly esteemed among Russians, that it is well worth the while of British manufacturers to break down the barrier which, more than the Customs dues, is hindering British trade. The internal conditions of Russian trade are at present far more satisfactory than they have been for many years; the war with Japan, followed by domestic troubles, has removed Russia from active business life for some time past, and the country has been relying largely on its great natural resources. At the present time Russia is altogether tired of politics, and desires only to keep what she has got. She is, therefore, entering upon a new era of economic development, which will result in increased commercial and industrial activity.

The relations between England and Russia are now most amicable, not merely as regards treaties, but also in national popular feeling, which goes a long way toward good business relations. Bills have been prepared by the Russian Government to provide for the registration of firms in Russia, the easier formation of limited companies, and other reforms tending to improved business. As regards electrical engineering, the prospects are already great; such matters as improved transit: the utilisation of the oil fields for power transmission: the development of such industries as cotton manufacture: and the exploitation of electric lighting, need

to be attended to at once. With regard to the latter point, the Russian, at any rate of the upper class, is a luxurious person and is fully aware of the convenience of electric lighting. In the town districts, therefore, there is as much scope for electric lighting as in England and America.

The first essential to the proper solution of the great engineering problems that lie before us in Russia is a thorough understanding of the economic conditions in Russia, and a suitable disposition of our terms of sale of machinery to meet them; and, secondly, the acquisition of a knowledge of the language by English representatives of firms who desire to do business in Russia.

The Greenwich Explosion.

The explosion of a thermal storage vessel at the works of the South Metropolitan Electric Supply Co. at Greenwich took place, we believe, on December 20th, 1906, and the Board of Trade inquiry only commenced on or about December 16th, 1907. It seems curious that so long a delay should have taken place in the investigation of so very serious an explosion. At the time of the accident it transpired that the dished ends of the exploded vessel were comparatively flat, and it was pointed out by steam experts at the time that such large dished ends ought not to have been trusted without stays, and that, if not stayed, they should have been hemispherical, like the egg-ended boilers once so common. But even an egg-ended boiler should have one very strong longitudinal stay-bolt as a safeguard in the event of a circular seam rip, for these have been very common in such boilers.

The delay in the investigation seems to us a very serious matter, for we believe that at least one other such thermal storage vessel has since been found to have developed a crack in the same place as the original crack in the exploded vessel. How it comes that such vessels, exposed to a heavy pressure and so very faultily and insufficiently designed—we refer, of course, to the flatness of the dished ends and the lack of stays—should ever have found acceptance it is difficult to understand. Presumably it is the object of the present investigation to ascertain this, and it would be out of place at this juncture to say much more. So far, the inquiry seems to have been pretty severe in certain directions, but it is postponed to January 16th, 1908.

Electric Railway Schemes in Germany.

It is stated that there never was a time more unfavourable than the present for seriously thinking of the actual realisation in the near future of the various schemes for the construction of electric railways in Germany. So protracted are the negotiations with the different authorities that many years are occupied in overcoming initial difficulties, and it is declared that no less than 20 years elapsed between the commencement of the preliminary work and the setting in operation of the Berlin elevated and underground electric railway, which is now being extended, although very gradually. Indeed, the Siemens & Halske Co., before being allowed to build this particular railway, is stated to have constructed a similar line at Buda-Pesth in order to convince the Berlin police authorities (?) that an elevated and underground railway did not belong to the class of technical impossibilities. However this may be, it is certain that things move very slowly in the Fatherland. The Ministry of War represents another factor in the situation. All electric railway projects are regarded by the Ministry with a certain amount of anxiety, as it is considered that it would be much more easy to destroy or interrupt the working of an electric railway, operated from a central power station, than to deal in a similar manner with steam lines having self-contained locomotives. The question of converting the main steam railway between Berlin and Hamburg was brought forward several years ago, and in order to further the scheme two of the leading electrical firms submitted a proposal to the Prussian State railway authorities for the construction of an experimental line between Hamburg and Kiel, which they offered to carry out mainly at their own expense, only slight aid being asked of the authorities. It has not yet been determined when this project shall be proceeded with, although the Minister of Railways has not shown himself disinclined to pass it. Negotiations have also been pending for some time between electrical firms and some of the Federal States for the transformation of their respective railways, but these have likewise made no progress. Apart from the Prussian State main line between Hamburg and Blankenese, the State of Hamburg has sanctioned an expenditure of £2,250,000 for the construction of a Hamburg city and suburban railway. This line is to be partly underground and partly high level, but the completion of the first section is not expected to take place before the lapse of five years. It is stated that German firms are also looking for electric traction work in connection with the Italian State railways, and likewise in respect of the St. Gothard railway, which will be taken over by the Swiss Confederation in the course of two or three years.

The Paris Lighting Sectors.

The exact position of the Paris electric lighting Sectors, or companies, seems a little involved. A new agreement, which extends to 1913, came into operation on November 1st, and the period between the present and the year 1913 is merely one of transition; the new company will then take over the whole of the lighting and power supply in Paris until 1940. During the next few years the Sectors are to continue work until the Compagnie Parisienne de Distribution d'Electricité, in which each of the existing Sectors is financially interested, assumes the whole of the responsibility. We observe it stated, however, that under the mutual agreement between the companies themselves on the one hand and the Municipal Council on the other, the concessions of some of the companies have been reduced, whilst those of others have been extended, and that those which have been granted a longer life have arranged to compensate those whose concessions have been shortened. The Secteur de la Place Clichy would appear to be placed in the latter category, and the Compagnie Parisienne de l'Air Comprimé has received an extension of 6½ years. It would seem that the Secteur de la Place Clichy, whose concession expired on April 15th, 1907, and was prolonged to November 1st, 1907, has ceased to exist, but this is impossible unless the undertaking was actually transferred to the Compagnie Parisienne de Distribution d'Electricité on the latter date. If this has not happened the Secteur de la Place Clichy, as in the case of the other Sectors, must be continuing its work until the appointed day in 1913.

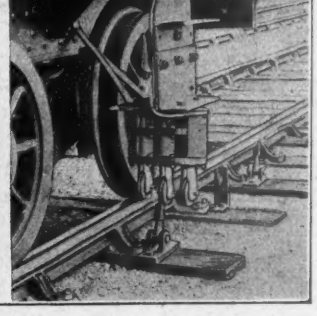
The Specific Heat of Superheated Steam.—In a paper presented by Prof. Thomas, of Itbaca, N.Y., to the December meeting of the American Society of Mechanical Engineers, the conclusions arrived at as to the specific heat of the superheated steam, determined experimentally, are first, that the specific heat varies with both pressure and temperature, increasing with the pressure, and diminishing with the increase of temperature. That it increases and decreases more rapidly near saturation point, as pressure and temperature respectively increase, than is the case in conditions more remote from saturation point. These conclusions apply over the whole range of the author's investigations, from 7 lb. to 500 lb. absolute pressure, and up to 270° F. of superheat at all the pressures employed. The paper contains some excellent diagrammatic plotted results in the shape of nearly straight lines, curves, from which may be gathered that if the results are correct, modern practice may be calculated on a basis of a coefficient of about 0·57, the curves becoming flatter slightly towards higher temperatures, which is not what one would anticipate from the knowledge of what occurs with more perfect gases, though it seems to be in accord with several of the more recent determinations on steam.

A NEW RAILWAY SIGNALLING SYSTEM.

Although not primarily an electrical system, the railway signalling system, invented by Mr. H. J. Jefcoate, of Crewe, and practically demonstrated there the other day before the Board of Trade representative, Lieut.-Col. Druitt, depends on electricity for its effective operation, and as many electrical engineers are experimenting with a view to providing a much needed improvement on our present system of signalling, with the consequent greater immunity of the travelling public from accident, especially in fog and through the liability of the human factor to err, considerable interest attaches to this patent.

The system is very simple and inexpensive. Briefly, it consists of three plain T-bars running parallel with the line and at varying distances from it. They are placed (1) "distant on" (slightly sloped) at the distant signal; (2) "home on" (level); and (3) "home off" (slightly sloped) at the home signal. These bars, mounted on cranks, are connected by a spliced wire to the ordinary signal wire, the signalman pulling the lever as for the existing semaphore. In the event of any disconnection the bars go to danger. Three plungers are fitted to the engine, one for each of the three bars. The plungers are mounted on ball-bearings, and are only called on to rise half an inch to complete contact. When the distant and home semaphores are put to "danger," the "distant on" and "home on" bars are raised, so as to engage with the corresponding plunger. In the same way when the home semaphore is pulled off, the "home off" bar is raised so as to engage its plunger as the engine passes. An indicator in the cab of the engine shows the driver the exact position of the signals, and whether he should proceed or stand still, and starts him after stopping

Signalling Device in Cab of Locomotive.

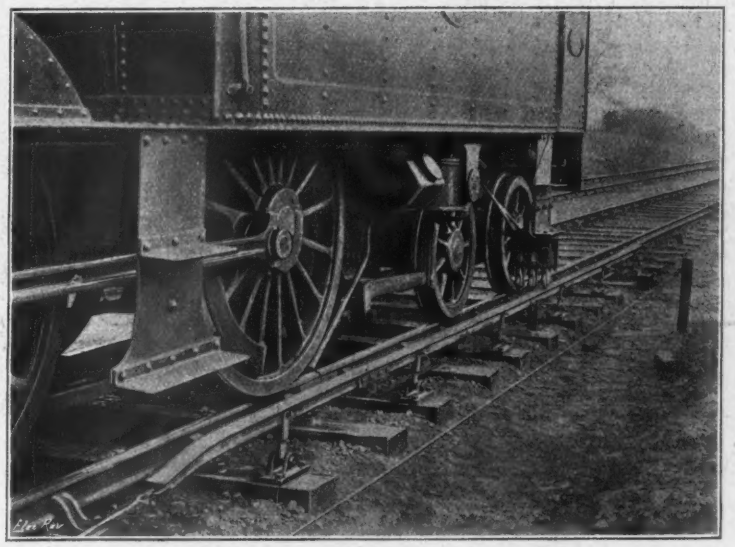


Arrangement of Plungers and Contact Bar.

when "line clear" has been given. In addition to the indicator reproducing the proper light and position of the signal arm, an alarm bell with a distinctive note for each separate signal is rung in the cab. The signal being thus unmistakable to the driver, who hears and sees it under all conditions, fogging, with its contingent heavy expense, is rendered unnecessary, The equipment of the permanent way is purely mechanical, and there is no mechanism between the metals to interfere with the working of water troughs or catch projections from the rolling stock, while no electrical apparatus is essential beyond a small battery on the engine, which is only in circuit at the moment of giving the signals.

The cost of the system is very low, roughly, 25s. per engine per year, while the cost per signal bar is about £3. A railway with a thousand engines and 10,000 signals would save £24,000 per year on fogging, snow-drifts and unnecessary piloting, to say nothing of immunity from disasters, big and little, now due to mistaken signals and fog.

Col. Druitt made a number of severe tests of the invention. All kinds of obstacles were placed in the way to try to upset the system, but they were in every case defeated. Large



Locomotive Standing at Contact Bar.

pieces of ballast were wedged between the castings, but when the system was put in operation, the stones fell away, and everything worked smoothly. Then the cab of the engine was enveloped in a tarpaulin sheet, so as to prevent those on the footplate seeing the ordinary signals, and top speed was attained by the engine. The signals were read without the slightest difficulty, and the train slowed down and stopped without the driver having received any outward sign. Col. Druitt's report is awaited with much interest at Crewe, especially by experienced engine drivers, who contend that if the system had been in operation it would have prevented the Shrewsbury disaster—providing the engine driver over-ran his signals—and that it would have been equally effective at Cudworth, Elliott's Junction, Grantham, and in other recent instances where the failure of the human factor led to a terrible loss of life and treasure.

LORD KELVIN.

The last great English man is low.
Mourn, for to us he seems the last,
Remembering all his greatness in the Past.—*Tennyson.*

There is a cadence in all great funereal music, which even the least musical of mortals instinctively recognises. It at once appeals to, and satisfies, our emotions. It speaks, indeed, of sorrow and of mourning, but there is in it also a note of thankfulness and pride, so that it seems incongruous, save in honour of the really great. The same characteristic is found in all worthy memorial poetry, from Lycidas to In Memoriam, or, to extend the range, from Catullus to Kipling. We hear the slow beat of the muffled drums, the note of regret, of irreparable loss is there, but underneath it all is a subdued note of triumph and of peace. Hence it comes that poetry on the death of one great man is often appropriate, in part at least, to another; that Shelley's lines on Keats:—

He has outsoared the shadow of our night;

are fittingly placed on Shelley's own memorial at Christchurch, and that we find in Tennyson's great ode on the death of the Duke of Wellington much that, without the alteration of a word, chimes in with our feelings when the

greatest natural philosopher of the age is carried to his last home in the Abbey at Westminster.

In Lycidas, in Adonais and in In Memoriam, the note of regret prevails, for the death mourned was untimely, and there is the inevitable thought of the might-have-been to embitter it; but to the death of the old we must perforce resign ourselves, we recognise that it is natural; and though the sense of loss, the gap in the foremost rank, the silence of the well known, well loved voice must needs cause sorrow, yet the prevailing feeling is one of pride in the great departed, and of thankfulness that he has lived.

> Peace; come away: the song of woe
> Is after all an earthly song;
> Peace; come away: we do him wrong
> To sing so wildly: let us go.

It says little for our critical acumen as a nation, or for our appreciation of scientific eminence, that worthy recognition of Lord Kelvin's pre-eminent genius has come from abroad rather than appeared in our own newspapers. The writers of the great mass—*The Times* is an honourable exception—of the obituary notices that have flooded the daily Press seem to have no conception that they are writing of a mind of an order that scarcely appears once in a century; he is compared with Gladstone, which is absurd, for Gladstone, great man and great orator as he was, was entirely unscientific if not anti-scientific; and with Edison, which is grotesque. True, he is often compared with Newton, but we suspect that those who made the comparison, know little of what Newton was or did. In some ways this comparison is valid. Both were men of incessant mental activity, and of apparent leisure; both were mathematicians, though in that respect Newton far outsoared all his contemporaries, and Lord Kelvin, though in the first rank, was not either alone there, nor even the greatest; both combined in a rare degree the power of abstract thought and daring physical speculation with high inventive faculty and experimental ability; both, too, were subject to fits of abstraction, which made them sometimes forgetful even of their meals—a peculiarity common to most abstract thinkers, notably Gauss. In some more personal and lovable respects, they were also alike, in modesty and in simplicity of character, and in the enthusiasm for science which absorbed them. Newton, at the end of his life, compared himself to a child gathering shells by the shore of the great ocean of truth; Kelvin, at his jubilee, confessed that his record with regard to the work which was the chief interest of his life might be summed up in one word: "failure." But it was the failure of Browning's grammarian:—

> That low man goes on adding one to one,
> His hundred's soon hit;
> This high man, aiming at a million,
> Misses a unit.

It need scarcely be said that we do not allude to Lord Kelvin's alleged inability to do an addition sum in the presence of his class.

The likeness between Kelvin and Helmholtz was somewhat nearer than many of the suggested comparisons, yet the two men had really little in common save a common interest in physics. The one was a mathematician while still a boy; the other was an astonishing example of the adage, it is never too late. In middle age he learnt physics the better to understand physiology, and mathematics for the sake of his physics, and attained the front rank in all three. But we are a little weary of such comparisons. We have no taste for ranging the eminent men of all nations in a class list, as though they were Civil Service candidates; nor, save in the mind of a born pedagogue, is there any criterion by which one may set off poetry against philosophy, or compare the statesman with the inventor, or either with the financier.

The keynote of Lord Kelvin's success was thoroughness; to him every problem that engaged his attention was a challenge, and his severely logical mind would not be put off with makeshifts. Hence there is a mark of finality about his many inventions. We never find a Kelvin instrument modified and improved by some other inventor. But so long as the end were obtained, he was comparatively indifferent to the means or the form. We have heard an engineer remark, pointing to a Kelvin electrostatic voltmeter, "That it had an amateur look about it. What engineer," he said, "would have stuck on a thing like that?" alluding to a small adjustable weight standing out on the moving vane. We ventured to suggest that it worked all right. "Oh, yes; it works all right, but it does not look like an engineering job." That is the characteristic of all his instruments, they work all right, and, because of that, in spite of his indifference to traditional usage, most of them *do* look like engineering jobs. This concentration of thought on the matter in hand, combined with his restless activity, quickness of thought and catholicity of interest in all mechanical and physical questions, accounts in some measure for the amazing versatility of the man and the enormous amount of work he could get through. His mind was ever occupied with great things, and he made small things—such as a water-tap—great if they chanced to engage his attention. Yet he was no recluse nor pedant. It was not for him to groan over the wasted hours of youth, given to unprofitable study of the classics; on the contrary, he congratulated himself all his life on having received an education which enabled him to appreciate humane literature. Nor did he disdain the sports and pastimes fitted to his age: at Cambridge he found time to excel in rowing, and won the Colquhoun sculls; he found time also for the delightful and humanising pursuit of music, and was president of the musical society there. Yet at the exceptionally early age of 21 he graduated as Second Wrangler and first Smith's prizeman. His biographers (of the hour) seem much exercised by his failure to be Senior Wrangler, and have invented an improbable story to account for Dr. Parkinson's success, to the effect that it was due to his being able to answer a question founded on one of Thomson's own researches which Thomson himself could not reproduce. In fact, Parkinson and Thomson met many times at the examination board, and here is the former's own account of their relative positions:—"In every examination in which we competed I was above him. Yet he knew, and I knew, and he knew that I knew, and the examiners knew, and everyone concerned knew that he was far the better mathematician." The faculty of turning out in a limited time answers to the greatest number of questions is a good test of knowledge of the subject matter of those questions; but it is a very poor criterion as between men who both possess the knowledge, which of them has it in the profounder degree. It may be noted that Maxwell and Clifford were also Second Wranglers, and that they, too, each turned the tables on the senior in the Smith's prize examination, in which pace counted for less.

This same quality of thoroughness accounts for his great "failure" no less than for his successes, accounts for the fact that half a century of thought, and such thought, brought him no nearer to an understanding of the relations between ether, electricity and ponderable matter, or of chemical affinity. It may be that the problems are in their nature insoluble; it may be that some solution may yet be found, in which case it is almost certain that the discoverer will owe a deep debt to Lord Kelvin's baffled efforts. Had he been less thorough, less logical, less conscious that science is one, not a thing in water-tight compartments, he might well have persuaded himself that he had made some real advance. But he had nothing in common with those who, because they find an unexplained line in a spectrum, are ready to jettison all they have ever held, and to reconstruct the universe and recall the fables of the alchemist respecting the transmutation of metals.

His boldness of speculation and his brilliant and original scientific imagination were shown in his vortex theory of atoms and his hypothesis of a rotatory ether; but in neither case did he regard his hypothesis as established fact. The vortex atom failed to account for the phenomenon of gravitation, and the rotatory ether was but one of many ways, none quite beyond cavil, of accounting for the transmission of radiant energy through apparently empty space. Of all his speculations the only one which was received with almost universal dissent was that of the meteoric origin of life on this planet. He objected to any theory of the spontaneous generation of living things, on the reasonable ground of want of evidence. He equally objected to the free use of the hypothesis of creative power, probably on the classical ground, *nec deus intersit nisi dignus*, &c. Therefore, since once the world was too hot for life of any kind, and there is now life on it, he enunciated the startling theory

that it had reached us through the medium of an aerolite. It seems strange to us that Lord Kelvin did not realise that so he was but putting the difficulty back a step; that ultimately he must still face the alternative of creative power or spontaneous generation. On this matter Clifford wrote many years ago :—

"We can only get out of spontaneous generation by the supposition made by Sir W. Thomson, in jest or earnest, that some piece of living matter came to the earth from outside, perhaps with a meteorite. I wish to treat all hypotheses with respect, and to have no preferences which are not entirely founded on reason; and yet, whenever I contemplate this

simpler protoplastic shape
Which came down in a fire-escape,

an internal monitor, of which I can give no rational account, invariably whispers 'Fiddlesticks.'"

Probably most of our readers will agree that on this occasion Clifford had the best of it, whether in wit or argument.

The story of the Atlantic cable, of heroic perseverance crowned ultimately with success, is familiar to our readers and need not be told again here. But it is noteworthy that neither perseverance had been reasonable, nor success attainable, but for the young Glasgow professor. It was he who solved the electrical problems that arose, and who thus secured the opportunity of his life. He was indeed fortunate in his opportunity, for his investigations of the theory of electricity and its relation to that of the propagation of heat in a homogeneous solid were undertaken some years before, as purely from a theoretical point of view as were Maxwell's investigations on the electro-magnetic theory of light. It was not till long after Maxwell's death that his theories bore fruit in electric wave telegraphy, but Thomson was able to see the outcome of his labours early in life, and to take a leading part in their practical development. Of his innumerable electrical instruments there is no need to write here; our readers meet them at every turn in their daily life. His association with submarine telegraphy doubtless gave occasion to his active intellect to busy itself with tidal records and deep-sea soundings, while the accident of his being asked to write an article on the compass led to his revolutionising the construction of those indispensable instruments.

As a professor, Lord Kelvin is said to have been hardly a success—at least, his success, such as it was, was rather by personal influence than by lecturing, save in the case of a very few advanced students. He was too impulsive, too apt to be carried away by any side issue that occurred to his fertile mind, and too far removed from the average intelligence of his pupils. It is part of the queer arrangement of things in this world that such a man should be set to teach boys, that a steam hammer should be made into a nut-cracker. He might have been a great teacher, but his class ought to have consisted of the pick of the physicists in Europe. None the less, he secured the respect and affection of his students, and took a genuine interest in their welfare and their future careers; but it was ridiculous to bind such a genius in the bonds of a syllabus.

All who have seen or heard Lord Kelvin, whether as expert witness in the Law Courts, as after-dinner speaker, or as lecturer before some learned society, must have been impressed by his enthusiasm and vitality and no less by his character and kindliness. He won the affection of many who never so much as exchanged a word with him. His sympathies were always ready, and he was easily moved to emotion. None who were present can forget his patriotic ardour on the occasion of the farewell dinner to the South African Corps of Electrical Engineers. In the Law Courts, he would not be hurried, and his abstraction was sometimes a trial to counsel. We remember him in the Harness case, utterly disregarding Sir Richard Webster's questions, while he was busy fitting the connections to the belt put into his hand. At last he got them fixed to his satisfaction, and then leaning forward he pulled the belt apart, sending the connections flying in all directions with the exclamation, "There's your belt!" It was in the same case that he was asked whether, amid his multifarious degrees, he had any medical standing. He replied that he was an M.D. of Heidelberg University, and had a licence to practise, but had never exercised it.

Full of honours, Lord Kelvin always received any address or testimonial of respect with gratitude and feeling. He never seemed to realise his own greatness, or to take anything as but his due, but was overwhelmed by the, to him, unexpected kindness. In the general mourning it seems selfish to air a private grief, yet the members of the Institution of Electrical Engineers must needs regret that their President did not live to deliver the Presidential Address, to which they so eagerly looked forward, and from which they hoped to learn so much. In modesty, in singleness of aim, in courtesy and in simplicity, the greatest of mankind have much in common, however diverse their talents and career; therefore, as we said at the beginning of this article, though no two men were more unlike than the Great Duke and the Great Philosopher, yet we find in the ode on the one a fitting epitaph for the other :—

Our greatest, yet with least pretence,

. . . . . .

Rich in saving common sense,
And, as the greatest only are,
In his simplicity sublime.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electrical Trades Benevolent Institution.

I shall be obliged if you will take the opportunity of again reminding your readers, at this time of the year, of the continued existence of the above institution.

I am glad to say that the institution is making progress in the collecting of funds, but I could certainly wish that the interest in it was more widespread, and that the funds came from a still greater number of individual members of the industry.

Any of your readers feeling an interest in the matter can obtain the fullest particulars from Mr. W. Davenport, Secretary of the National Elec. Manufacturers' Association, 2, Queen Anne's Gate, Westminster, S.W.

One of the Committee.

Osram and Tantalum Lamps.

The above lamps are certainly of considerable benefit to the average user, but are decidedly not so to station engineers and contractors, whose profit (if any) is swallowed up in paying for lamps *supposed* to have been sound when *despatched* by the manufacturers, also in replacing lamps which go absolutely black after a few hours' use. Unfortunately, we are in the hands of the manufacturer, who does not seem to realise that our results eventually become his result, as was the case with Nernst lamps. I know several contractors who have given up fitting the above, and, unless we get better terms, we will do likewise.

Station Engineer.

Bremer Lamp Patent.

With reference to the letter of the British Westinghouse Co., published in your last issue, we beg to say that the statement made therein as regards the decision of the Comptroller-General, is quite inaccurate. This decision has not been arrived at, nor has the Comptroller-General allowed the claim for amendment. A statement of this nature anticipating the decision of a public official upon a matter still under his consideration, is of so serious a character that we prefer not to comment upon it further.

We are quite prepared to prove by documentary evidence that the action brought against us by the Westinghouse Co. for infringement of patent was *abandoned by them* in July upon our putting in proof, in our defence, of anticipation of the patent. We hope, in fairness to ourselves, you will publish this letter, so that no misapprehension shall exist on the point in question.

D. Santoni & Co. (1906), Ltd.
J. A. Chewns, *Secretary.*

London, E.C., *December 20th*, 1907.

GREAT INTERNATIONAL EXHIBITIONS.

(*Continued from page* 1033.)

1893, Chicago, £61,464.—Under a Royal Commission formed out of the Council of the Society of Arts represented by Sir Henry Trueman Wood, the secretary, Lord Justice Fletcher Moulton being in charge for three weeks. For this exhibition the principal Government grants were:—Germany, £180,000; France, £163,588; Austria, £12,500, and Italy, £8,000. The Commission lasted for three or four years. They were first granted £25,000, but after nine months, and chiefly for political reasons, this was increased, and a *cachet* was thereby given to the exhibits. The Council of the Society of Arts was not, however, very well fitted, as a body, to manage such an undertaking. They were strongly urged to get more money on account of the great efforts being made by France and Germany. The Government did not send many exhibits, but their pavilion, a very substantial building of brick and terra-cotta, called the "Victoria House," was much admired. It pleased the Americans immensely, and was purchased by them at a nominal sum as a yacht club, and is still standing, being considered a delicate return for the lavish hospitality shown. The furniture placed in it was an exhibit, and for fear of injuring it, the house was little used at first, though the regulations were subsequently relaxed after a protest from the British exhibitors. A good collection of British economic materials was shown, and might have been useful for subsequent exhibitions, but, as usual, it was dispersed. It was estimated that the average value of each exhibit was £715, while the expenses amounted to £374, or a total of £115,000 spent by the exhibitors—nearly double the Government grant. Yet, except in the opinion of some members of the Government, the British exhibits, as a whole, were disappointing. The management generally was pretty fair, but there were complaints that the officials were not practical business men and laid themselves open to charges of inattention. In fact, the exhibitors formed a club of their own, and entertained the Colonial Commissioners, amongst others. It was considered that the exhibits (especially the machinery) were good in themselves, but were very badly displayed, giving rise to some caustic remarks to the effect that the British section "looked like a workhouse" managed by "well-connected ignoramuses evidently appointed simply to provide them with well-paid employment" under a scientific man with no business capacity. Soaps and patent scents were given such prominent places that other nations laughed "to think this was a specimen of what Englishmen made." The funds did not allow of any general decoration, which, as each individual nation was kept together, might have been very effective. The Agricultural and Machinery Halls, moreover, were very far apart. The political relations were not as cordial as they are now, and the tariff injuriously affected British trade; these causes, combined with the usual jealousy amongst manufacturers and traders—a jealousy which the Engineering Standards Committee is doing much to dispel—caused the exhibits to be not as satisfactory as could have been wished either in quality or quantity. Attempts were made to procure collective exhibits of Irish industries, of pottery and of electrical apparatus, but they all failed. There were no juries, and bronze medals (the only ones) were awarded by individual judges, who in many cases and in different ways were "nobbled"—in fact, the system proved hopelessly bad. The exhibitors paid for transport to and from the buildings and a duty of 60 per cent. on all the goods they sold in the country, and yet many of them had much difficulty in finding their empty cases, and, indeed, some of the samples went astray and were never recovered.

Turning to other nations, their expenditure was estimated to amount to 12 millions. The Germans, who were participating for the first time in a great international exhibition, made a great show—but then, their Commissioner practically had *carte blanche*. Their pavilion was an imposing structure, and though only of lath and plaster, cost as much as the British one, and is still standing. The exhibitors sent their goods to a central organisation, which took charge of them and sent them over. The German Consul engaged two clerks specially to attend on exhibitors; by their help many hundreds of accounts were opened, and German firms got well established in Chicago. Further, one of the exhibitors in the German scientific section was paid by the Government to take charge of it and to give all explanations. The *Comité Français des Expositions à l'Étranger*, besides the amount already mentioned, succeeded in obtaining 41,627 sq. metres of ground space for their 2,762 exhibitors. Their furniture section was most beautifully arranged. Both these nations made grand collective exhibits. Their Governments paid the whole cost of installation and decoration, but did not entertain much.

1894-5, Tasmania, £2,000. Under a Royal Commission, is the only information regarding this exhibition to be gathered from the Committee's report.

1894, Antwerp, £388. Under the Consul-General at that place, assisted by the Greek Acting Consul. There was no money for proper organisation, and the Consul, who had no previous knowledge of the subject, openly regretted that he had undertaken it under the pressure of local influence. Exhibitors were left to struggle as best they could from first to last, and the result was unworthy of Great Britain. The occasion was of some importance; the *entente cordiale* with Belgium was closer than it is now, and if this country could not be adequately represented, the exhibition should have been left severely alone. The International Exhibitions' Committee of the London Chamber of Commerce was formed at this time.

1897, Brussels, £4,753. Under a Committee of the London Chamber of Commerce. Sir Albert K. Rollit, as President of the Chamber, and as Chairman of the above Committee, was asked to undertake the formation of what was in fact a "Royal" Commission for the exhibition by Lord Curzon, then Under-Secretary of State for Foreign Affairs, and Chief of the Commercial Department of the Foreign Office. A grant was made to the Commission, accompanied by a suggestion from the Under-Secretary that the late Mr. James Dredge, C.M.G., one of the proprietors of *Engineering*, should be the Commissioner. Before the total amount of the grant had been settled, Sir Albert and some of his friends, members of the Chamber of Commerce and merchants in the City of London, raised a guarantee fund of £6,000, which, however, was not called upon; indeed, £800 of the grant was returned when the accounts were closed. Mr. Dredge accepted the position, and being a commercial man in the best sense of the word, and being backed by an energetic and enthusiastic chairman, he did wonders with the money and in the time at his disposal. Indeed, his wide connection compensated for any slight the Belgians might have felt at the lack of official participation. As usual, opinions differed widely as to the success of the Exhibition; while some considered that England was poorly represented, and that our industrial exhibits, owing to their inartistic arrangement, looked like a second-rate bazaar, others were pleased, not only at its financial success (*i.e.*, the return of a large portion of the grant), but at the whole organisation as being the best in many ways that we had had up to then. Perhaps it was a case of "bad is the best." The sanitary earthenware makers transferred their showrooms, as it were, to the Exhibition; the Cleveland Ironmasters' Association and the Leeds Chamber of Commerce made collective exhibits; the Staffordshire pottery and bedstead trades were well represented. Opinions differed as to the value of the machinery exhibits, owing to the limited space available; but, on the whole, and seeing the short time at their disposal and the amount of the grant, the managers did very well. The fact of Great Britain having a section to herself was a distinct advantage, and the awards were satisfactory. This was due, no doubt, in a great measure, to the fact that the British jurymen went over some time before the juries went round, and "really pulled them (the international juries) by the nose."

(*To be continued.*)

Guisborough Electric Lighting.—It has been decided that a special meeting of the Council shall be held to discuss the question of electric lighting in the area.

PROCEEDINGS OF INSTITUTIONS.

Automatic Cab-Signalling on Locomotives.

By J. Pigg, Member.

(*Abstract of paper read before the* Institution of Electrical Engineers, *London, December 5th, and Newcastle, December 9th*, 1907.)

Introduction.—Of late years the subject of the signalling of railways—that part by which instructions are given to the drivers of trains—has received a good deal of attention; a number of systems has been devised and put forward for supplementing the ordinary outdoor mechanical signals, but, practically, no progress has been made in their application.

If we carefully consider the operations involved in that mass of conventions known as the "block system" (in which term is included all apparatus used for signalling), we find that the sole aim of that complex system of signalling is the exhibition of appropriate signals to the drivers of trains for their guidance, and that it implies implicit observance on their part of the signals exhibited. Whilst the signalmen, by whom the driver is guided, are provided with reminders to a certain extent, and hedged about more or less completely with restrictions on their actions, the driver must rely upon his physical powers to enable him to observe and obey the signals by which he is to be guided.

A study of the causes of railway accidents will show that collisions have been caused by:—

(*a*) The signalman at the receiving end of a section giving permission for a train to enter the section before it is clear of the preceding train.

(*b*) The signalman at the sending end of a section allowing a train to enter the section before he has obtained permission to do so.

(*c*) The driver of a train ignoring the signals exhibited for his guidance at that point.

The driver is by far the most important of the three men engaged, and every means should be taken to ensure his duly receiving the guiding instructions provided for him. During the last two years the author has been associated, in a minor part, in experiments having in view the best means of supplementing the ordinary signals given to drivers. The apparatus has been designed by Mr. Vincent Raven, the chief assistant mechanical engineer of the North-Eastern Railway, by whose permission the author is enabled to give the details which follow, and to show one of the instruments fitted to a model representing the locomotive and a section of line as used in practice. The system is essentially an electrical one, which aims at reproducing, in the cab of the locomotive, all the information that the driver now obtains from the present mechanical signals, but is not intended as a substitute for those signals.

The "distant" signal is one of the greatest importance, since at that signal the driver is informed of his position relatively to the stopping place of that signalling point, and he there obtains the "condition of line" and "route" indications if the line has been prepared for his further passage. What is required, therefore, in any supplementary apparatus is that it shall advise the driver, when he is passing a position corresponding to that fixed upon as the distant signalling point, of the condition of the "stop" signals in advance. If this is done, the driver is informed on all the points which it is necessary for him to know. The following points should be provided for:—

1. To inform the driver of his position relatively to the signalling point he is approaching, at such a distance as will enable him to carry out any steps that may be necessary.

2. To advice him immediately afterwards of the condition of the "stop" signals he is approaching, *i.e.*, whether they are "on" or "off."

3. If the "off" signal is obtained it should be accompanied by a "route" indication, which will enable him to judge whether the right road has been prepared at a diverging junction. It should be possible to reverse this indication at some point or points before the train passes the "home" signal, in case of emergency, just as it is possible to reverse an indication with the mechanical signals by throwing them to "danger" before they have been passed.

4. If the "on" signal is obtained, the indications on the engine should be maintained until the "off" signal is received. It should be possible for the driver to receive the "off" signal at some point or points between the "distant" signalling point and the "home" signal, to prevent unnecessary delay; to be informed at some point or points how far he has travelled between the distant signalling point and the stop signal when the indication continues at "on"; and to obtain the "off" indication when standing at the "home" signal. It should also be possible to give a signal to a train standing at the "home" signal which would be of a cautionary character and distinguishable from the ordinary authority to proceed.

As corollaries, the following should also be provided for:—

(*a*) The warning signal should require no action on the part of the driver or signalman to bring it into operation.

(*b*) The "condition of line" and "route" signals required under (2) should be under the sole control of the signalman, should be subject to the control imposed by the interlocking, and must be such that failure shall not be liable to give a dangerous false indication.

(*c*) The signalman shall be provided with indicators which will show him that the apparatus on the line, for giving the signals on the engine, is in order, and that the apparatus prepared is in accordance with the positions of the signal levers.

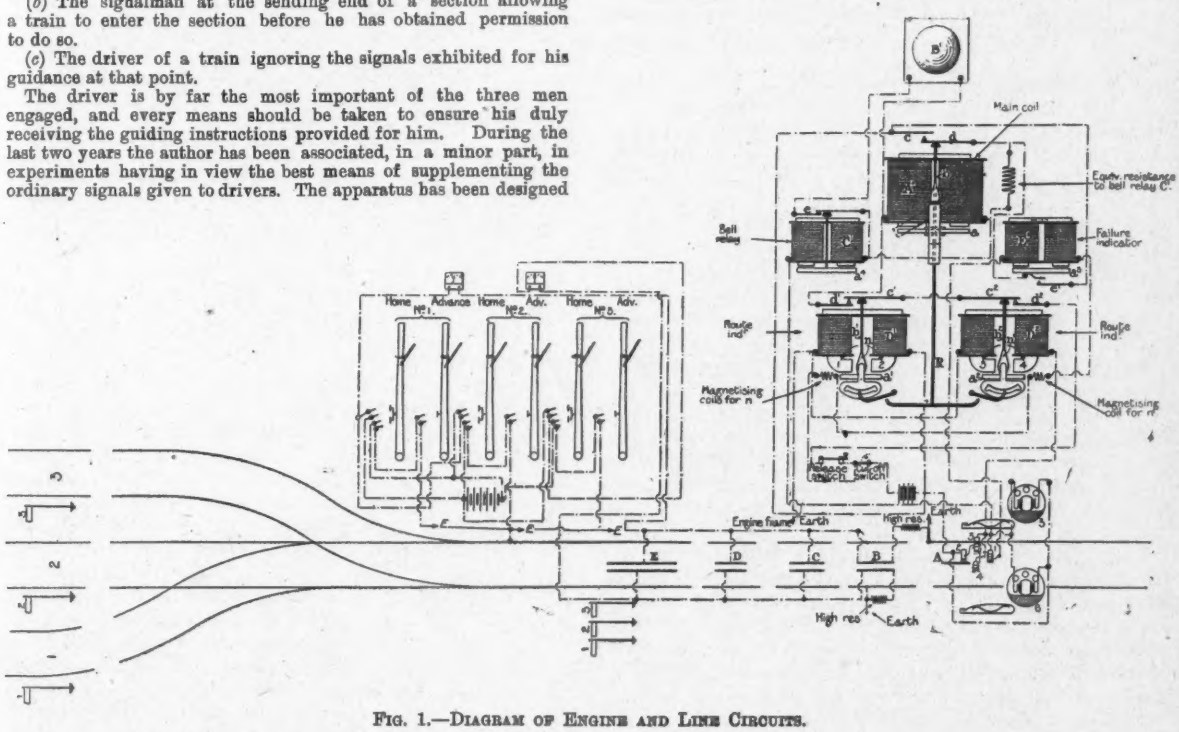


Fig. 1.—Diagram of Engine and Line Circuits.

(*d*) The apparatus on the engine should be of a reliable character, easily seen and heard, and such that the indications shall, as far as possible, correspond with the apparatus it is intended to supplement. It should be self-testing and be continually in use, so that failure may be instantly indicated, and it should be so arranged that attention can be readily given and defective apparatus easily removed and replaced.

(*e*) The apparatus should be capable of easy adaptation to single or double line working.

Raven's Electrical System of Cab-signalling.

This system is designed to collect indications by the rubbing of metallic brushes (fig. 3) carried on the engine, over metallic bars (fig. 7) placed on the line.

The visual signals are (1) a small semaphore arm by which the "condition of line" signals are given, and (2) two small pointers showing 1-2 and 3-4 respectively, which are the "route" indicators. The audible signals, which are of the nature of "call attention" signals, are given by a bell. Besides these indicators, the instrument carried on the engine includes a visual "failure" indicator, by which the condition of the apparatus can be gauged.

Fig. 1 shows in diagrammatic form the complete equipment of engine and line circuits, the latter being for a three-way diverging junction. Fig. 4 shows the back of the engine indicator.

The action of the apparatus is of the simplest possible character, the main principle being the invariable operation of the apparatus

at certain points by the natural action of certain parts without the aid of either the signalman or the driver, and the subsequent continuance of the indications resulting from the natural operations until they are stopped or reversed by the action of the signalman.

Considering fig. 1, and leaving, for the present, consideration of the line of bars out of the centre of the space between the running

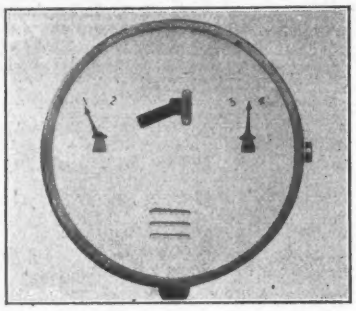


FIG. 2.—INDICATOR IN CAB, SHOWING LEFT-HAND ROAD AT DIVERGING JUNCTION, OR STRAIGHT ROAD; LINE CLEAR.

rails, it will be found that the short-circuiting of brushes 1 and 2 on, say, bar A, causes a current to pass through the main magnet, A^1, by which its armature is raised, putting the semaphore arm to "danger." At the same time the armature closes the circuit of the springs c, d, diverting the current direct back to the battery after passing through A^1. Hence the armature of the latter will remain attracted to the poles as long as may be necessary for the purposes of the apparatus.

Besides passing through A^1 and the brushes, the initial current passes through the bell relay C^1 during the continuance of the short-circuiting of the brushes 1 and 2; the armature is attracted and breaks the circuit through the spring contact (e). This contact forms part of the bell circuit, which itself is connected in shunt

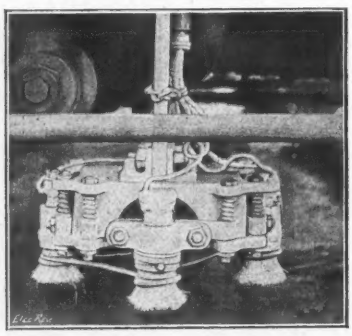


FIG. 3.—STEEL WIRE BRUSHES, 1, 2, 3 AND 4, CARRIED ON ENGINE. SHOWING "FAILURE" INDICATOR CIRCUIT WIRE WRAPPED AROUND BRUSHES.

across the electro-magnet A^1. Hence when the armature of A^1 is raised, the current from the engine battery tends to divide, part passing by A^1 and part by the bell. The connections, however, are such that current only passes to the bell when C^1 is unenergised, and this condition only obtains when the brushes 1 and 2 are not short-circuited. When the brushes are on a metallic bar, say A, therefore, the bell is silent, but as soon as they pass off the bars it commences to ring.

In addition to passing through the electro-magnets A^1 and C^1, as described, the current to the brush 1 passes through the springs c^1 d^1, and c^2 d^2, each pair of which is normally in contact. These springs are opened by the raising of the armatures of D^1 and D^2 respectively. Opening the circuit at either c^1 d^1 or c^2 d^2 obviously releases the armature of A^1, and, as a consequence, stops the ringing of the bell and lowers the semaphore arm.

Currents passing through D^1 are collected from the line by the brush 2, currents passing through D^2 are collected from the line by one or other of the brushes 3 and 4.

Between the poles of D^1 and D^2 are placed magnetised needles n, n^1, pivoted to turn under the polarity of the poles when the electro-magnets are energised. The spindles carry the pointers shown in fig. 2. Each spindle also carries a small metal sector, slotted as shown by figs. 1 and 4, in which rides a small metallic loop, pivoted at the other end. The passage of a current through, say, D^1, deflects the needle to one side, and the loop drops into a recess at the end of the slot, and locks the needle and pointer on the front of the instrument in the deflected position. At the same time that this occurs, the lifting of the armature of D^1 breaks the contact c^1 d^1, and lowers the semaphore arm, and stops the bell as already stated.

The engine carries, in addition to the apparatus described, two rotary switches, of which further details are shown in figs. 5 and 6

Each switch consists of a cast-steel wheel free to rotate, the spindle of which carries a two-part commutator, on which bear two springs. The wheel is weighted so as to take up a normal position. In this position the springs bearing on the commutator are insulated from each other, but when the wheel is rotated they are connected through the commutator. The springs are connected with the brushes 1 and

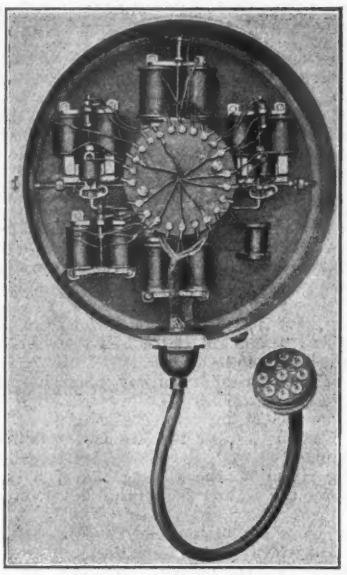


FIG. 4.—BACK OF CIRCULAR TYPE OF INDICATOR. COVER REMOVED EXPOSING APPARATUS.

2 respectively, and each rotary switch, when turned from its normal position, connects the brushes in the same way as the latter are connected when on the bar A, or any subsequent bar of those shown in fig. 1.

The rotary switches 5 and 6 run over fixed bars on the line side of the general form shown on the diagram. These bars are fixed in close proximity to the bar A, as shown by fig. 7. Hence the rotary switches are only actuated at or near the bar A.

Turning now to the line equipment, the point represented as being approached is, as already stated, a three-way diverging junction. The six levers shown represent the "home" and "advance" signals for each of the diverging lines. Each "home" lever is fitted with a double-pole, and each "advance" lever with a single-pole, switch, which are operated by the levers in the ordinary movement for operating the signals. The "home" and

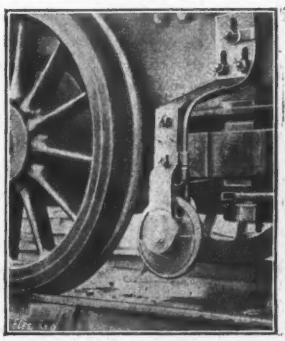


FIG. 5.—ROTARY SWITCH FIXED ON ENGINE BOGIE, SHOWING SERRATED PLATE FOR CONVENIENCE OF ADJUSTMENT.

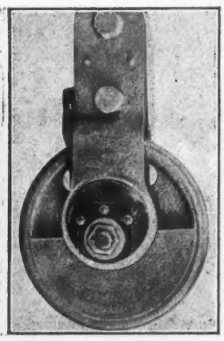


FIG. 6.—ROTARY SWITCH WITH COVER REMOVED, SHOWING COMMUTATOR AND SPRINGS.

"advance" levers for the lines marked Nos. 1 and 2 connect the battery in the cabin with the bars B, C, D, E, placed in the centre of the track, the only difference being that the levers marked 1 apply the positive pole of the battery to these bars, and the levers marked 2 apply the negative pole to the same bars. The two levers, No. 3, connect the battery in the cabin to the supplementary bars, and if the junction was a four-way one, other levers would reverse the polarity precisely as is done by levers No. 2.

As will be seen, the battery is not applied to the bars unless both the "home" and the "advance" signal levers are pulled over. The mechanical interlocking prevents the levers for more than one line being pulled over at once, or the "home" signal

for one line and the "advance" for another, and therefore, in the case under consideration, there is no need for more than one battery.

A view of the bar A is shown in fig. 7. It is mounted on wood blocks, which are in turn mounted on stoneware reels. The insulation is not high, as there is no need to aim at a high degree of insulation for this bar. Bars B, C, D, E should be well insulated, and they are therefore mounted upon double-shed porcelain insulators of the ordinary telegraph pattern.

A further consideration of fig. 1 will show that the preparations made for signalling to trains are indicated in the signal cabin. The two indicators required in the case of a three-way or four-way diverging junction are shown in fig. 1. When the levers are pulled over, the current passes through a high resistance fixed at bar B, which limits the current passing before and after the engine reaches the signalling bars, but which, being in shunt with the

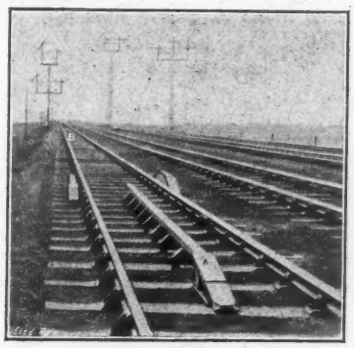


FIG. 7.—BAR A IN CENTRE OF TRACK. SPRING OR YIELDING BARS IN ADVANCE. BAR B IN CENTRE OF TRACK IN DISTANCE. DISTANCE BETWEEN A AND B, 100 YARDS. "DISTANT" SIGNALS (IN DUPLICATE) "OFF" FOR "ROUTE" 1. LENGTH OF BARS A, B, C, D, 30 FT. LENGTH OF BAR E, 60 FT.

engine circuits when signals are being given, does not affect the current to the comparatively low-resistance circuits of the engine. The resistance of the indicator is kept low with the same object. The permanent deflection is comparatively small. When the signals are being given the deflection is increased, and it can be used as an indicator to the signalman (1) of the position of the train which is approaching, and (2) whether the signals are being *given* on the engine.

Consider now in further detail what takes place in a typical instance. Assume that an engine is approaching the junction shown in fig. 1, and that line No. 1 has been prepared for it to pass forward. The "home" and "advance" signal levers No. 1 are both in the "off" position, and the battery in the cabin is connected positive to line. All the bars E, D, C, and B, are connected to the battery. Bar A is never connected to the battery, and is in no way under the signalman's control.

When brushes 1 and 2 are on bar A, the current from the engine battery passes through c^2 d^2, c^1 d^1, A^1, C^1, brush 1, brush 2, and to the battery. At practically the same instant, the same circuit is separately established by each of the rotary switches 5 and 6. The semaphore arm is put to danger, and as soon as the brushes are clear of the bar, the bell commences to ring. Ordinarily the time occupied in passing over the bar is from $\frac{1}{2}$ to 1 second, so that the bell practically begins to ring simultaneously with the raising of the semaphore arm.

The visual and audible indications given at bar A continue until the brushes, or brush 2, comes into contact with the bar B. A current then passes from the bar B to brush 2, thence to the coils of D^1, and the engine frame, and the rails, &c., to the battery in the cabin. The armature of a^1 D^1 is raised and breaks the circuit through the springs c^1 d^1, lowering the semaphore arm and causing the bell to stop ringing. At the same time the polarised needle n is deflected so that its pointer indicates 1, and the wire loop drops into the depression and locks the pointer in the position it has taken up (fig. 2).

The visual and audible signal given at bar A is a "warning" signal, indicating locality with reference to the signalling point being approached: the reversal of the "warning" signal is the "off" signal. If the further passage of the train on its journey to the "home" signal be followed, it will be found that the bell will ring momentarily at the instant the engine passes over each of the bars C, D, E, but no change is made in the character of the visual indication.

The indicator now shows the "off" signal by the semaphore arm, and route 1 by the pointer. These indications continue until the next signalling point is reached, and are a reminder of the last signal received.

Assume that the engine has reached another bar A. The same actions take place as described for the previous signalling point, but, in addition to raising the semaphore arm, the electro-magnet A, by the rod, B (fig. 1), raises the wire loop out of its recess, and allows the pointer to assume its normal position. We assume again, also, that the road has been prepared for the train to pass forward, but, in this case, it is the right-hand road of a two-way diverging junction. On reaching the bar B, the same operations are carried out with the exception that No. 2 route is shown. It happens, however, say, that at the time the engine obtains the "off" signal, and "route" indication, 1,000 yards away from the cabin, the signalman is being informed of a circumstance which makes it imperative for him to stop the train if possible, and he instantly throws his "home" signal to danger, and immediately afterwards the "advance." The engine at the moment is just reaching bar C, say, and on passing on to it, the "off" signal shown by the semaphore arm is reversed and danger shown, the "route" indicator is displaced, and the bell commences to ring as soon as the engine is completely over the bar. These indications will continue as long as may be necessary.

These actions constitute the receipt of a "warning" signal, the "off" and "route" indications and an "emergency" signal, calculated to avert a disaster from circumstances which have suddenly arisen.

Assume now that another bar A, belonging to another signalling point has been reached, precisely the same effects are produced there as have been already described. The line, however, has not been prepared for the passage of the train. On arrrving at bar B the bell stops ringing momentarily, but the semaphore arm remains at danger. Immediately the brushes have left the bar the bell recommences. The same effects are produced at bars C, D and E if no other signal is obtained at either of those points. The last bar is placed close to the "home" signal and is double the length of the other bars to allow of the train being brought to a stand easily with the brushes on the bar.

Hence the "on" signal is obtained by the continuance of the "warning" signal after the engine has passed over bar B, and that indication is continued until a subsequent indication is given by the signalman. The "on" signal, moreover, is of such a character, considered in view of the momentary stoppages of the bell by the intermediate bars, as to enable the driver to locate his position between the point at which he obained the "warning" signal, and the "home" signal at which he must be prepared to stop.

Assume that as the engine approaches the bar D, the signalman lowers the "home" and "advance" signals. When the brushes come upon the bar the "off" signal and "route indication" 1 will be received precisely as already explained.

Hence the "on" signal originally received at B may be reversed, and an "off" signal may be obtained at points between B and the first "stop" signal just in the same way as the driver sees the line signal lowered before he reaches it in clear weather by the projection of his vision.

Making another assumption, suppose that the engine has been brought to a stand on bar E close to the "home" signal, and is waiting for the receipt of an "off" indication. The semaphore arm is at "danger" but the bell is silent. The signalman lowers the "home" and "advance" line signals for the train to proceed. Immediately the semaphore arm on the engine is lowered, the "route indication" 1 appears, and the bell commences to ring and continues to do so until the brushes have left the bar.

Hence, the receipt of the "off" signal when standing at the "home" line signal is given, and the driver's attention is called to the change by the bell commencing and continuing to ring.

Suppose, now, that instead of sending the train straight away after bringing it to a stand at the "home" signal, the signalman wishes merely to call the train forward to communicate with the driver, or to bring the train forward to the "advance" signal, the signalman lowers the "home" signal and works the "advance" signal lever back and forward.

The semaphore arm on the engine will be worked up and down and the bell will ring intermittently and call the driver's attention to the character of the indication given.

Hence a cautionary or "calling on" signal can be given to trains standing at the "home" signal, and the indication is of a different character to other signals obtained in that position.

In the foregoing description the signals have been given for a two way diverging junction, or for a straight road. Suppose a train travelling to the signalling point in fig. 1, and that road No. 3 has been prepared for it. The brushes 3 and 4 are connected together, so that either is available for the same purpose. As shown by the diagram, brush 4 will engage with the bars parallel to B, C, D and E. The "warning" signal is given by brushes 1 and 2 on A as before. On the arrival of the engine at B, the brush 4 takes the current from the bar, after which it passes through the coils D^2, deflecting the needle n^1 to 3, and by the raising of the armature breaks the contacts c^2 d^2. The wire loop drops into the recess at the end of the slot in the sector, and locks the "route" indicator in the position required. The net result is precisely the same as described for the "route indications" 1 and 2, with the exception that the first of another pair of such indications is given. Had the junction been a four-way one, the action of the levers for the signals for the fourth line would reverse the polarity of the bars, and the indication 4 would be obtained. The next operation of the electro-magnet A frees the "route indicators," 3-4, precisely as described for 1-2. The double brush, 3-4, is to enable signals to be obtained whether the engine is running engine or tender first, towards a three-way or four-way junction, and it is also used in connection with single line working to be described later.

Failure Indicator on Engine.—The means for testing the condition of the circuits and battery on the engine have not yet been referred to. The actual indicator is a small disk or a grid appearing at an opening in the front of the instrument, which is white when the engine battery is in operation, and red if the battery fails or is cut off. The "failure indicator" circuit is independent of the other apparatus. Current is taken to the coils of E^1 from one end of the battery, and thence to the brush 2, which completes

the circuit. Interposed in this circuit are two small electro-magnets, the poles of which embrace the polarised needles n n^1, and tend to preserve their magnetism. As the "failure" indicator is always in action when the engine is in work, there is a constant current available for this purpose. In carrying the "failure indicator" to brush 2, the insulated wire is wrapped around all four brushes as shown in figs. 1 and 3. Hence any obstruction on the line which displaces the brushes will break the "failure" indicator circuit and bring it into action. The "failure" indicator magnet E^1 has a back contact, e^1, which is open when E^1 is energised, but is closed if the armature, a^3, is released. This contact simply bridges the open springs, c, d, of A^1, and if the armature a^3 is released, through the breaking of the circuit of E^1, the semaphore arm rises to danger, the bell commences to ring, and the disk or grid shows red. When the battery fails, the disk or grid shows red.

The engine equipment available for single or double line working only differs from fig. 1 in the addition of a small three-pole, three-way switch. In the centre position of the switch the apparatus is ready for double line working, engine or tender first. In the left-hand position it is available for single line working, engine first; and in the right-hand position for single line working, tender first.

The peculiarities of single line working require modifications of the track apparatus to obviate the receiving of signals on an engine proceeding in one direction, from the track apparatus provided for traffic proceeding in the opposite direction, on the same pair of rails.

(*To be concluded.*)

Institution of Post Office Electrical Engineers.

On March 11th, 1907, a paper (which has recently been printed) on the Baudot Printing Telegraph system was read at the above Institution by Mr. A. C. Booth, staff-engineer of the Post Office. The paper commenced with a brief sketch of the life of the inventor, from his early struggle and rise in the French Government Telegraph service, to his promotion to the Legion of Honour and death in 1903.

The general principle of the system is dealt with, leading on to a detailed description of the keyboard, receiver and distributor. The Baudot double and quadruple arrangements are fully explained, and are followed by a recommendation for duplexing the different arrangements, viz., double duplex, giving four channels; quadruple duplex, giving eight channels; and sextuple duplex, giving twelve channels. Mention is made that Baudot duplex has already been tried, but abandoned. As, however, underground lines provide much steadier line conditions, the lecturer advocates the application of Baudot duplex to these lines, and gives a diagram of the proposed arrangement of apparatus.

A description of repeaters then follows, dealing with repeaters for working in one direction on one line, and in both directions on the same line, and of another form of repeater known as a re-transmitter.

The output of the apparatus is fully considered, both from the point of view of speed of working in words per minute, and in actual number of Post Office messages carried in the hour.

From the figures quoted, Baudot easily obtains first place with the sextuple arrangement and second place with the quadruple, Wheatstone being given third place.

For Wheatstone working the speed is taken at 100 words per minute, but as it will work at 400 words per minute on a suitable line, it would easily beat Baudot sextuple. Again, the Hughes will work at its normal speed on much more difficult lines than the other systems, and would then probably equal in output any of the faster systems.

The lecturer recognises this in saying that there are so many considerations that have a bearing on the most suitable system to employ, that given certain conditions, any one of the systems mentioned may be the best in the circumstances.

A useful comparison is made of the different Baudot speeds in terms of Wheatstone speed; so that given the speed of a line in Wheatstone words per minute, it can be seen at a glance what Baudot arrangement will be suitable for that particular line.

Another useful table is given of the electrical data and speeds of the Post Office underground cable between London and Glasgow.

The Baudot alphabetical keyboard sender having a separate key for each letter is next described. It perforates a paper tape which passes automatically through a small transmitter at the back of the perforator. The tape is not torn off as in other perforated tape systems, but feeds forward continuously at about $\frac{1}{2}$ in. per letter, giving continuous transmission at 30 words per minute.

In conclusion, the Baudot is compared with the latest printing telegraph system invented by Mr. Donald Murray.

RECENT EXHIBITIONS.

Royal Society of Medicine.

Electro-Therapeutical Section.

The main features of the exhibition held on December 13th at the small Queen's Hall, were X-ray apparatus and coils. Only a few electric baths were shown, and apparatus for the application of faradic, galvanic and other currents—terms which, to the lay electrician, convey little significance. The collection of exhibits was nevertheless highly interesting. The following were some of the chief items:—

Messrs. Siemens Bros. & Co., Ltd.—New tantalum X-ray tube, which is fitted with an uncooled tantalum anti-cathode. This metal has a very high melting point, and is not liable to disintegration, so that it is permissible to allow the anti-cathode to become incandescent without fear of injury. Efficiency, constancy of vacuum and long life are amongst the advantages claimed for the new device, which is illustrated herewith (fig. 1). To "harden" the tube, the wire usually connected to the anode is attached to the supplementary terminal for a few seconds; to soften it, the flexible wire is brought near the cathode terminal when the tube is working.

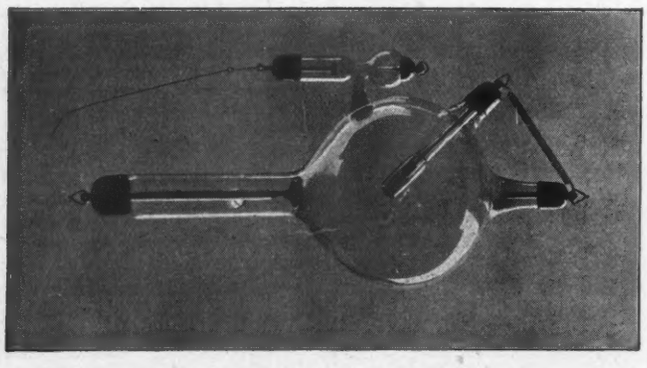


Fig. 1.—Siemens Tantalum X-Ray Tube.

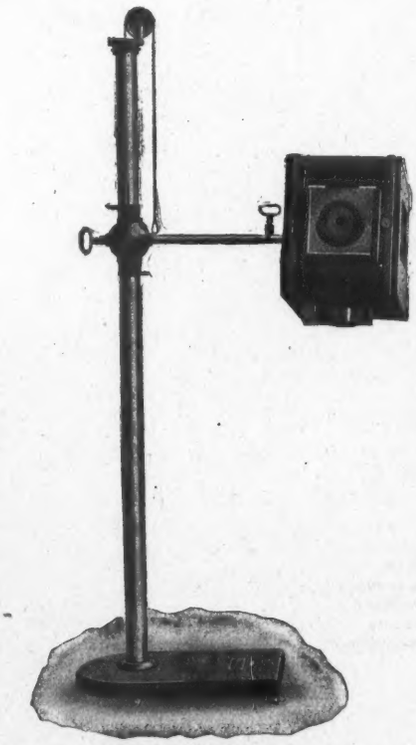


Fig. 2.—Siemens Protective Tube Stand.

On the other hand, the light emitted by the incandescent anti-cathode may interfere with observations with the fluorescent screen. To provide against this, and at the same time to shield the operator and patient from the harmful effect of the X-rays in directions where they are not required, Messrs. Siemens have also introduced a protective tube stand, consisting of a wooden box lined with protecting material and equipped with lead diaphragms, observation window of lead-glass and all necessary adjustments. This is also illustrated (fig. 2).

Other exhibits were a 20-in. spark induction coil with variable primary, working with either a mercury or a Wehnelt interrupter, all of which were controlled by a single combination switch; and Dr. Albers-Schönberg's compressor and couch, complete, with the latest stereoscopic fitting, and a special lead-lined screen for hospitals.

Messrs. Marconi's Wireless Telegraph Co., Ltd.—A variety of induction coils, &c., of which the most noteworthy was the company's new high-frequency apparatus. The special feature of this was that the frequency could be regulated to any desired value by means of a small handle on the front of the apparatus, which acted upon the capacity of the condensers; at the same time the intensity of the current could be varied from zero to a maximum by the rotation of the secondary coils, which were pivoted vertically and nicely balanced so as to turn easily, the relative strengths of current being indicated on a scale. Thus any dose can be recorded, and repeated at will.

Messrs. Harry W. Cox & Co., Ltd.—Heavy-discharge induction coils, interrupters, and X-ray tubes.

Mr. H. Helm.—"Sirius" X-ray tubes, in particular one with a water-cooled anode, for long exposures with strong currents, and provided with a vacuum regulator. This was shown working with a Gaiffe interrupter, valve and ondoscope, the current taken being 3½ to 4 milliamperes; it will stand 10 ma. for one minute, and is used in London and other hospitals.

Mr. K. Schall.—A variety of instruments and apparatus, including coils, X-ray tubes and radiographs, baths, &c. The principal feature was the new ortho-diagraph of Dr. Levy Dorn,

Fig. 3.—Orthodiagraph.

which is illustrated herewith. This instrument consists essentially of a fluorescent screen, X-ray tube, and diaphragm, all of which are mounted in a direct line with one another, and with a pneumatic pencil, on a frame which can be moved in any direction in a plane at right angles to the line of apparatus. With this instrument the observer can trace out the exact outline, for instance, of a patient's heart and record it on a drawing board by means of the pneumatic pencil. Thus the apparent enlargement of the heart, due to its shadow being thrown from a small source of divergent rays upon a screen, is avoided.

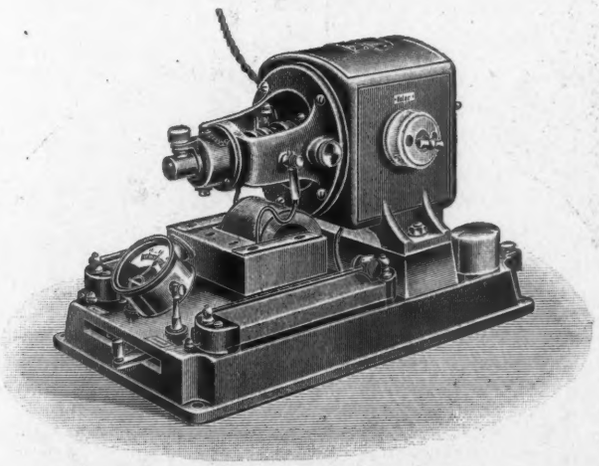


Fig. 4.—Schall Rotary Converter.

Another interesting device, for which Mr. Schall claims priority, was a small rotary converter, which, besides supplying sinusoidal alternating current when fed from D.C. mains, which is passed through a transformer to give current at low pressure for cauteries, &c., drives various instruments, such as drills and massaging implements, and supplies current for lighting surgical lamps. The apparatus can be used for galvanisation and electrolysis, a milliamperemeter and rheostats being provided.

Messrs. Newton & Co.—Heavy-discharge coil, with change-over switchboard for mercury and electrolytic break; large pattern of Wehnelt electrolytic interrupter; and a large Wimshurst machine, driven by a motor. A complete high-frequency apparatus, as

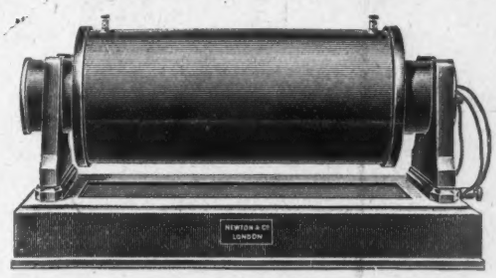


Fig. 5.—Apps-Newton Heavy-Discharge Coil.

supplied to the Bangour Village Hospital, Edinburgh, was shown. The H.D. coils, it is stated, give out 25 ma. with a spark of 15 in., and with their use the time required to photograph any part of the human body is reduced to a few seconds. A special series of windings has been worked out, so that the coil can always be constructed so as to secure the best possible results from the supply voltage and

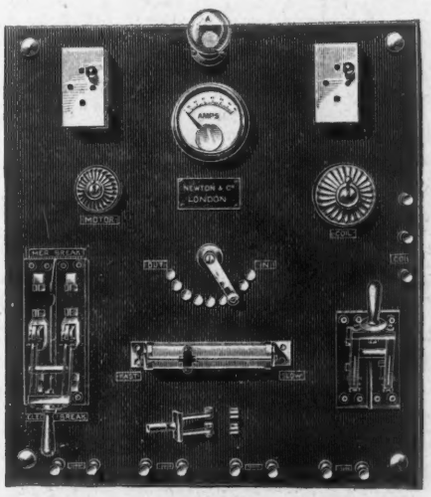


Fig. 6.—Newton Change-over Switchboard.

current available; the usual primary current is about 20 to 25 amperes. Provision is made for varying the primary winding to adapt the same coil for both Wehnelt and mercury interrupters, and the special change-over switchboard above-mentioned (fig. 6) enables this to be done and the interrupter changed with a single movement.

Messrs. Watson & Sons.—On several stands there was seen a neat little mercury interrupter, working in an atmosphere of coal-gas, and driven by a simple synchronous motor from the core of the induction coil. This was the Béclère or "moto-magnetic" interrupter, the sole rights to which are possessed by Messrs. Watson. The general appearance of the interrupter is shown in the accompanying illustration, fig. 7. The mercury is driven up a spiral channel in a revolving block of metal, in the form of a jet which strikes stationary teeth as the cylinder rotates; this portion of the apparatus is enclosed in an air-tight metal reservoir A, which can be filled with coal gas by means of the nozzles C. The cylinder is connected to the S-shaped iron armature B, which revolves in front of the core E. On spinning the armature with the fingers, by means of the milled head G, it continues to revolve; its speed is regulated by the relation between the moment of make and break of the primary current and the position of the armature with regard to the core of the coil, and this is easily controlled by means of the insulated arm D, which turns the interrupter round through a small arc. With coal-gas as a dielectric, no sludge is formed, and the mercury hardly needs any cleaning; in fact, the interrupter can work for at least 500 hours without attention. The mercury cannot be upset, and the device works equally well with any voltage from 24 to 250 volts, silently and steadily. The height over all is only 4⅜ in., and the weight complete 5½ lb.

This excellent device is used by Messrs. Watson in conjunction with their "intensified induction coil," the primary of which is of

heavy copper wire, with several taps, and the secondary has fewer turns than usual. With this coil, 15 to 25 ma. can be passed through an X-ray tube, and the time required to obtain a photograph is only 5 to 7 seconds. A large number of X-ray negatives

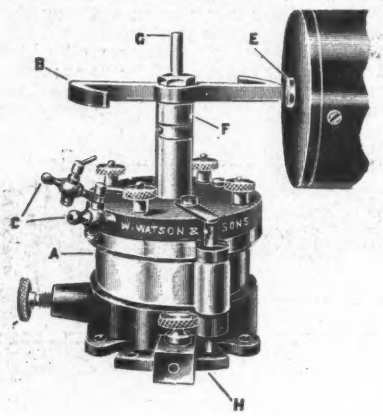


Fig. 7.—Watson (Beclere) Interrupter.

were shown, taken in this way. The company also exhibited a very large spherical rectifying tube, a tube-holding device of simple pattern, and a radiographic couch designed by Dr. Ironside Bruce, with the X-ray tube below, and the photographic plate above, their positions being set by means of an indicator.

Messrs. A. Favre & Co.—"Beta" X-ray tubes, with air-cooling device, invented by Mr. H. Bauer. The anti-cathode is a heavy copper disk, supported by a copper cylinder upon a glass tube, the interior of which is air cooled. The anode is not usually connected to the anti-cathode in these tubes; but a spark-gap is provided. Thanks to this, the anti-cathode never becomes the anode, and consequently it is not disintegrated. Reverse currents, it is stated, are never met with in these tubes. When the tube is hard, the anode is connected with the anti-cathode through a choking-coil. A specially interesting tube shown by Messrs. Favre was a stereoscopic tube, by means of which, with only two photographs, the depth, and distance from a given point, of a bullet, for instance, can be at once ascertained with the aid of a specially-graduated pair of compasses.

Mr. Leslie Miller.—Jointless-section induction coils, mica valve, &c. (see Physical Society, below).

Messrs. Sanitas Electrical Co., Ltd.—This firm had a large space in the centre of the room, and exhibited at Stands 9 and 19 a comprehensive variety of apparatus, including Finsen lamps of

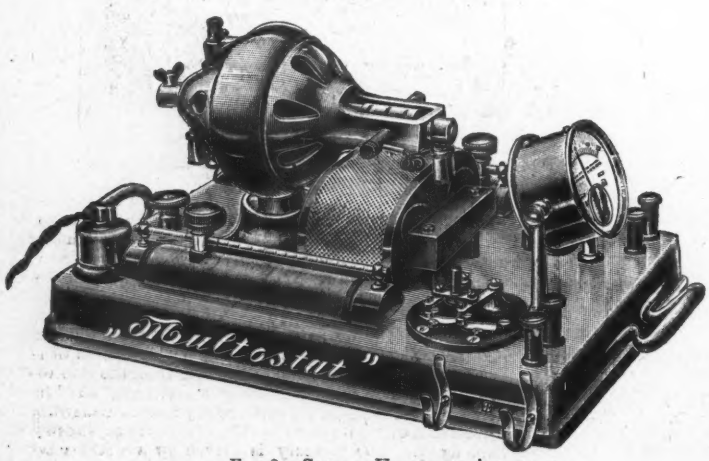


Fig. 8.—Sanitas Universal Apparatus.

various types, quartz mercury vapour lamps, vibrators, batteries, &c. A light bath was shown, and Dr. Schnee's patent four-cell bath for local application to the arms and legs. A special feature was the company's new "Multostat" universal apparatus, providing in the one machine galvanisation, sinusoidal and galvano-sinusoidal currents, cautery and light. This apparatus was provided with a dead-beat milli-ammeter, with three readings, viz., 0-6, 0-60, 0-600 ma. The rotary converter of this machine is adapted for working all kinds of surgical drills, vibrators, centrifuges, pneumatic ear massage pumps, epilation knives, &c., and is equipped with controlling rheostats, switches, milli-ammeter and pole-reverser. It connects with any continuous-current main from 50 to 250 volts, by wall-socket or lampholder.

At the No. 9 Stand the company were showing one of their multi-section spark coils and a new pattern bi-polar high-frequency apparatus on the induction principle; also a new protecting box-screen for guarding both operator and patient against the effects of the X-rays.

The chief feature of the company's exhibit was a new type of mercury interrupter for X-ray and high-frequency work, shown in public for the first time. The chief point of this new invention is

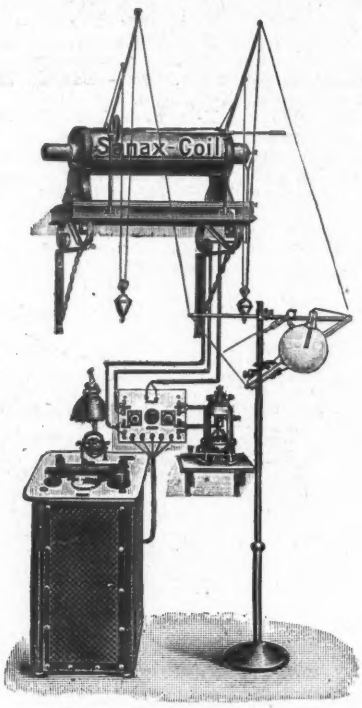


Fig. 9.—Sanitas X-Ray Outfit.

that it is possible to obtain interruptions as rapid as a Wehnelt interrupter (about 8,000 to 10,000 per minute) without any of the drawbacks of the Wehnelt type. This interrupter is known by the name of "Sanax." The principle underlying its construction is very ingenious.

Fig. 10.—"Sanax" Interrupter.

When the motor rotates it takes with it a small pear-shaped bowl, arranged perpendicularly above and direct coupled to it. In this is placed about 1 lb. of mercury, which, by centrifugal force, travels up the bowl and forms a ring round the extreme periphery of the bowl. Inside the bowl is placed a disk on a vertical axle, mounted towards one side of the bowl, so that the ring of mercury in rotating drives the disk by friction; this wheel has four alternate segments of metal and insulating material. The speed of the motor is about 2,500 R.P.M., and the segmented disk being only about half the diameter of the bowl, it rotates about 5,000 times per minute; as it is provided with two metal segments, it must make and break contact twice to each revolution, and thus the exceedingly high number of about 10,000 interruptions per minute is obtained.

By this means any ordinary coil can be made to give an output exactly as required, to suit the ever-varying vacuum of different

focus tubes, so that a soft tube for therapeutic and radiographic purposes can be used as well, without over-straining, as a very hard tube, such as would be necessary for a screen examination of the chest or pelvis.

Physical Society of London.

The third annual exhibition of the Society, while not remarkable for any startling novelties, brought forth numerous interesting features, and was admirably housed in the new Royal College of Science. Whilst we have not space to deal in detail with all the exhibits, we give below a brief account of a number of them of special interest.

Messrs. J. Pitkin & Co. showed their Holden-d'Arsonval galvanometers, with laminated steel magnet, as shown in the accompanying

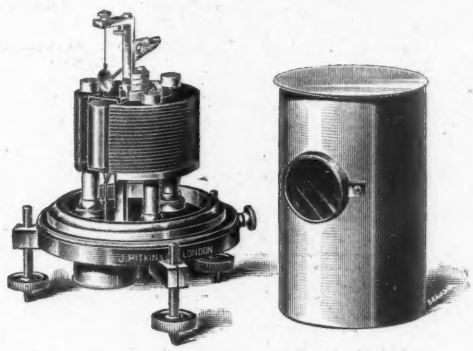


Fig. 11.—Holden-d'Arsonval Galvanometer.

illustration, and the Pitkin-White pyrometer, which is also illustrated, the latter being used in conjunction with a thermo-couple, and reading direct in degrees Centigrade. They also

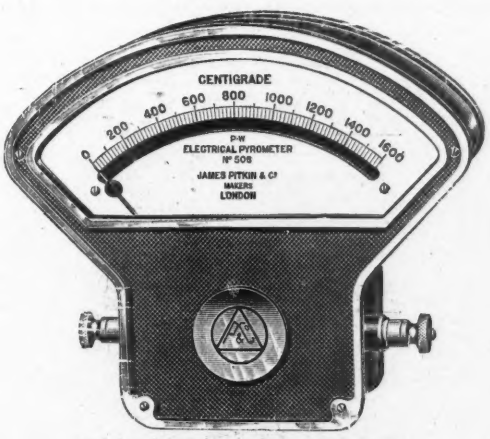


Fig. 12.—Pitkin-White Pyrometer.

exhibited a number of galvanometers, ampere and voltmeters, and resistance boxes.

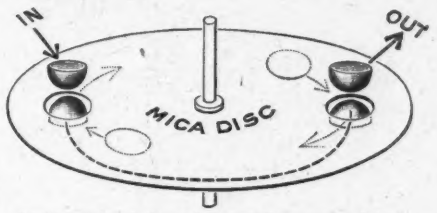
Mr. Robt. W. Paul was exhibiting several pieces of electrical apparatus of quite new design. Among these may be mentioned Cohen's barretter, with which Mr. Cohen was demonstrating his methods of making telephonic measurements. This apparatus was described in the inventor's paper before the I.E.E. A quaint feature of this exhibit was the galvanometer. It was a reflecting galvanometer constructed on the single-pivot principle; it had only to be suspended from a wall batten by means of odd pieces of wire, after the manner of a picture, in order to get it into the required position, and it was hanging much out of plumb. Nevertheless, it was working quite satisfactorily, showing the excellence of the balance, and the immunity from vibration possessed by the instrument.

Another entirely new instrument was the Campbell vibration galvanometer. This apparatus consists essentially of a very narrow coil carrying a mirror, and suspended between the poles of a powerful magnet. The periodic time of this moving system may be adjusted by turning a knurled knob, underneath the instrument, and perfectly accessible. Turning this knob raises or lowers a centre pillar, carrying a projecting arm to which the upper suspension is attached by means of a spring, the tension on which can thus be varied. The range of adjustment of the periodic time of the instrument by this means is from about 50 to 300 complete oscillations per second. The lower suspension is bifilar, and an adjustable clamp, enabling the effective length of this bifilar suspension to be shortened, provides a further range of adjustment up to 800 or 1,000 oscillations per second. Such an instrument is exceedingly useful in many alternating-current measurements, the tuning to the periodicity in use enormously increasing the sensitivity. When in synchronism with the impressed current, the instrument constitutes a very sensitive alternating-current detector, the sensitivity being of the order of one millimetre per 10^{-7} ampere, at one metre, and it should be of great value for measuring capacity, self and mutual inductance, &c.

Mr. Paul also exhibited a fixed and an adjustable standard of mutual inductance, designed in accordance with Mr. Campbell's paper recently read before the Physical Society. The adjustable standard has a range of from 1 to 10,000 micro-henries.

Galvanometer lanterns for Nernst lamps and 4-volt fairy lamps were also shown, as well as two new forms of universal shunt.

Mr. Leslie Miller exhibited a 12-in. jointless section induction coil, wound on his patent system, with parts showing the



Position at break shown full; position at make, dotted.

Fig. 13.—Miller Mica-Disk Valve.

method. This coil was worked off the 110-volt mains, in series with a regulating resistance, by the Béclère mercury interrupter, which we describe elsewhere, and in addition a new device—a

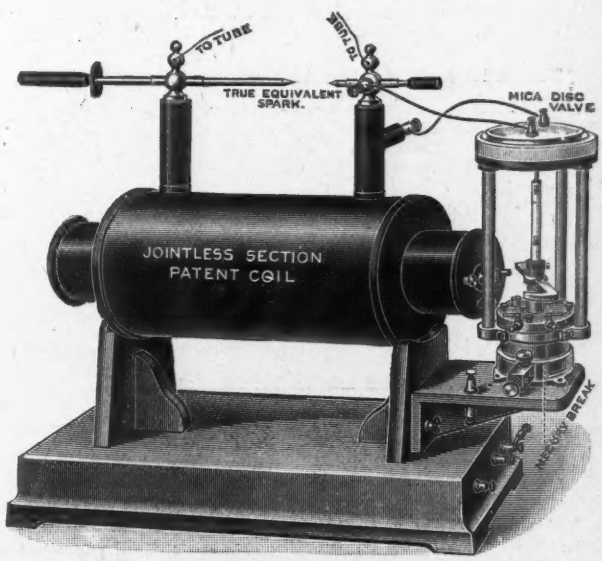


Fig. 14.—Miller Coil, Mica-Disk Valve, and Mercury Break.

mica-disk valve, recently invented by Mr. Miller—was driven by the break, with which it was in synchronism. The valve, as shown in fig. 13, consists of a circular plate of mica about $\frac{1}{16}$ in. thick by 6 in. in diameter, and offers a high resistance to the "make" E.M.F. in the secondary winding, whilst at the moment of "break" there is only a small air-gap of about $\frac{1}{4}$-in. in circuit with the secondary, so that the current is rendered practically unidirectional, a very important feature in X-ray work. It is pointed out that this is not a true non-return valve, as it does not stop reverse oscillations in the secondary due to the primary condenser; but these are practically negligible. An interesting application of the jointless section system of winding is to a resistance coil of 30,000 ohms, in which the direction of winding is reversed at every other disk, so as to make the coil non-inductive.

Messrs. Everett, Edgcumbe & Co., Ltd., had a large exhibit of their flicker and Universal photometers in use, Hamilton electrostatic voltmeter, inkless recorder, resonance frequency indicator, resistance bridge, and portable measuring instruments.

Messrs. J. J. Griffin & Sons, Ltd., showed many interesting physical apparatus, including an experimental arc furnace, a Dolezalek quadrant electrometer, and a new electroscope, designed by Prof. Rutherford for accurate measurements in radio-activity, such as the comparison of the activity of substances, and the determination of the rise and decay curves of the radio-active products. As shown in fig. 15, p. 1050, the instrument consists essentially of two parallel plates A and B, the upper of which is connected to the gold or aluminium leaf system C through the sulphur cone S, the lower plate being connected to the base of the instrument.

The electroscope is charged by the projecting rod D, which after charging is covered by a metal cap E. The material to be tested is placed on the lower plate B, which is made to slide in and out.

Care has been taken to make all the essential parts easily removable, in order to admit of rapid replacement either of a gold

leaf or of the metal plates A and B, should they by accident become contaminated by radio-active matter. The instrument is constructed of aluminium and mounted on a cast-iron base.

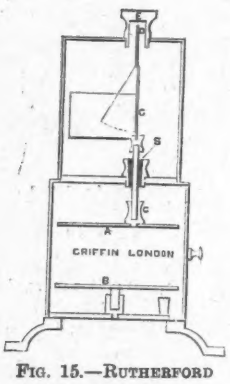


FIG. 15.—RUTHERFORD ELECTROSCOPE.

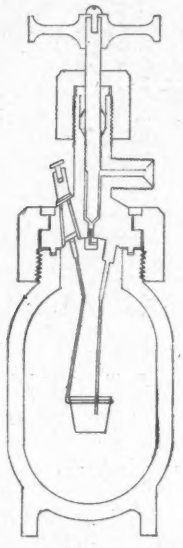


FIG. 16.—MAHLER-COOK BOMB CALORIMETER.

The Mahler-Cook bomb calorimeter, in improved form, was also shown.

The accompanying illustration shows in vertical section the pressure vessel, in which the material tested is burnt in compressed oxygen gas. The bomb is of steel, lined with a special enamel, with a heavy screwed cover, and is tested to 3,000 lb. per sq. in. before despatch from the works. In the measurement of the calorific value of fuel the latter is placed in the crucible shown, and after admitting oxygen at a pressure of 20 to 25 atmos., is ignited, and a temperature curve is obtained. From the data recorded and the known water-equivalent of the apparatus, the desired result can then be calculated. It is claimed that the bomb calorimeter is the most accurate for testing fuel.

(To be continued.)

LEGAL.

RHONDDA TRAMWAYS CO., LTD., AND THE TAFF VALE RAILWAY CO

IN the Court of Appeal on Thursday (December 19th), before the Lord Chief Justice, the President of the Probate, Divorce and Admiralty Division, and Lord Justice Buckley, the appeal was heard in the matter of an arbitration between the Rhondda Tramways Co., Ltd., and the Taff Vale Railway Co.

Mr. Eldon Bankes, K.C., and Mr. Goldberg (instructed by William Hill & Co., agents for Ingledew & Sons) were for the appellants; Mr. Bailasche and Mr. Marriatt (instructed by Deacon, Gibson, Metcalfe & Co., agents for Morgan, Bruce & Nicholas) represented the respondents.

MR. BANKES said the facts of the case were these. The Council obtained powers to construct a tramway along certain roads, and in some portions of their course the roads crossed the lines of the railway company at right angles, and at varying heights from the ground there were a great number of telegraph wires. It was left to the Council to decide what form of traction they should adopt, and they decided upon the trolley system. There were Board of Trade regulations which, unless modified, required that the line wire should be 12 ft. from the ground and the protecting wire a few feet above it. The telegraph wires which crossed the three railway bridges—Llynypia, Wallshoim and Pentygwath—were not a sufficient distance from the ground to enable the cables to pass under, and the Council thought there were Sections under the tramways which enabled them to deal with the situation, and they claimed that the matter in dispute should be settled by arbitration. The Council contended that their case came under Sec. 30 of the Tramways Act, and he contended that they had mistaken their powers in this respect. The case was taken from the arbitrator to Mr. Justice Bray, for his Lordship to decide whether the arbitrator was right in deciding in favour of the Council, and saying the case came under the Tramways Act, and not under the general powers. Mr. Justice Bray decided in favour of the Council, that they had power to alter the wires where necessary, and that it was expedient for the Council to do this work, and that they had power to go upon the railway company's land to carry out such work. It was against this decision that they had appealed.

Without calling upon Mr. Bailasche, their Lordships delivered judgment. The LORD CHIEF JUSTICE said he was clearly of opinion Mr. Justice Bray had correctly interpreted the law, and he was of opinion he had decided correctly. The Council unquestionably had the powers they claimed. To the questions which were submitted for the consideration of the Court below, Mr. Justice Bray had decided against the railway company. In doing so he was right, and this appeal must be dismissed with costs. The other Lords Justices concurred.

DREDGE *v.* EAST HAM CORPORATION.

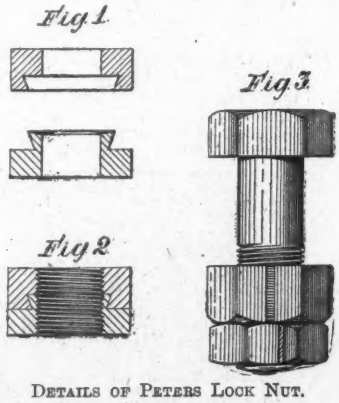
BEFORE Mr. Justice Lawrance and a common jury in the King's Bench Division on Friday, Mr. John Thomas Dredge, a laundry canvasser, claimed damages against the East Ham Corporation for personal injuries sustained on October 17th, 1906, when an electric tramcar, belonging to the defendant Corporation, collided with a van in which plaintiff was seated. The accident occurred in High Street, South East Ham. As a result, Mr. Dredge suffered from severe abdominal injuries and shock. The defendants admitted negligence on the part of their servants, and the only question was one of damages.

The jury awarded plaintiff £100. As that amount had been paid into Court, judgment was entered for the defendants, with costs.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Peters's Patent Lock Nut.

Lock nuts have ever been a fruitful field for invention, and now another new device has been put on the market by the GLOBE PATENT LOCK NUT CO., Bloomsbury Street, Wolverhampton. As shown in the accompanying figures, the lock nut in place resembles the ordinary double nuts, but it will be seen from the section that one nut is dovetailed into the other, so that the two are inseparable. They are tapped in this condition, and when the lines marked on



DETAILS OF PETERS LOCK NUT.

them are set together the nuts turn easily as one; but on tightening up the outer on the inner, by virtue of the shape of the joint a powerful grip is obtained, which, it is claimed, far exceeds that of any other combination yet invented. A special feature of the nut is the fact that the outer nut, which carries the load, is the longer. Common practice places the thin nut outside, but this is an error, though it may be convenient in the absence of a thin spanner. In this respect also the nut is to be commended.

Xmas Slide Rules.

MESSRS. CALLENDER'S CABLE & CONSTRUCTION CO., of Hamilton House, Victoria Embankment, E.C., have favoured us with a very handy cable calculator, which embodies the principle of the slide rule.

This device, which we show herewith, consists practically of a rectangular diagram, in which the diagonals represent cable areas; the two horizontal slides contain the factors relating to yards, volts and KW., and the two vertical slides serve to adjust the remaining factors, *i.e.*, system of supply, power factor, and percentage loss in volts marked on. The use of the rule is a very simple matter, which will be better appreciated by reference to the particular example for which the rule is set in our view. Here 1,500 yd. represents the *distance of route*, and this figure on the "yards" scale is placed opposite arrow I; the lower horizontal slide is adjusted until arrow II points to the pressure in volts, *i.e.*, 1,000 in the case shown.

The right-hand vertical slide is then moved to bring arrow III opposite the particular cable system required, B, which represents the *common return in a two-phase three-wire system*; and the left-hand vertical slide to bring arrow IV opposite the suggested power factor of the system—taken at ·9 in. in our example, which completes the actual adjustments.

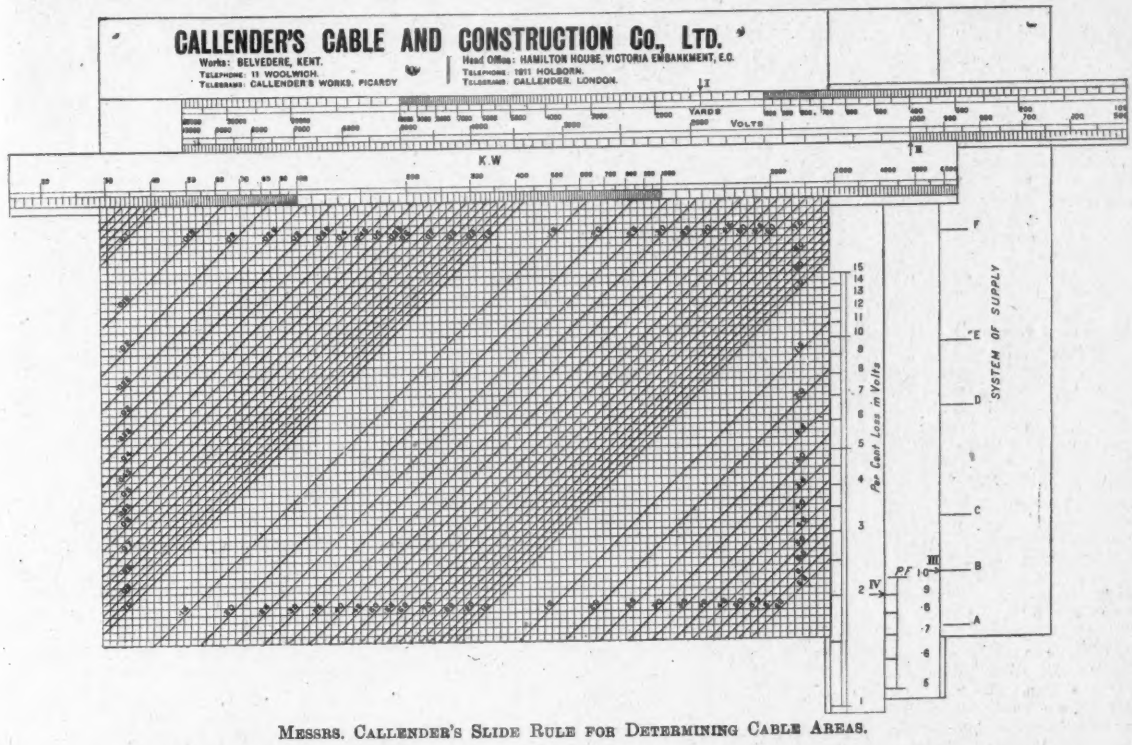
Knowing the number of KW. proposed to be transmitted and the allowable loss in the line, it is now only necessary to find the point of intersection of the vertical (KW.) line and horizontal (loss) line, and the nearest diagonal line gives the required size of the cable in square inches.

The device is constructed in millboard with card slides, and is provided with an instruction card behind, from which we note that the result should always be examined to see that the current density does not exceed the safe limit.

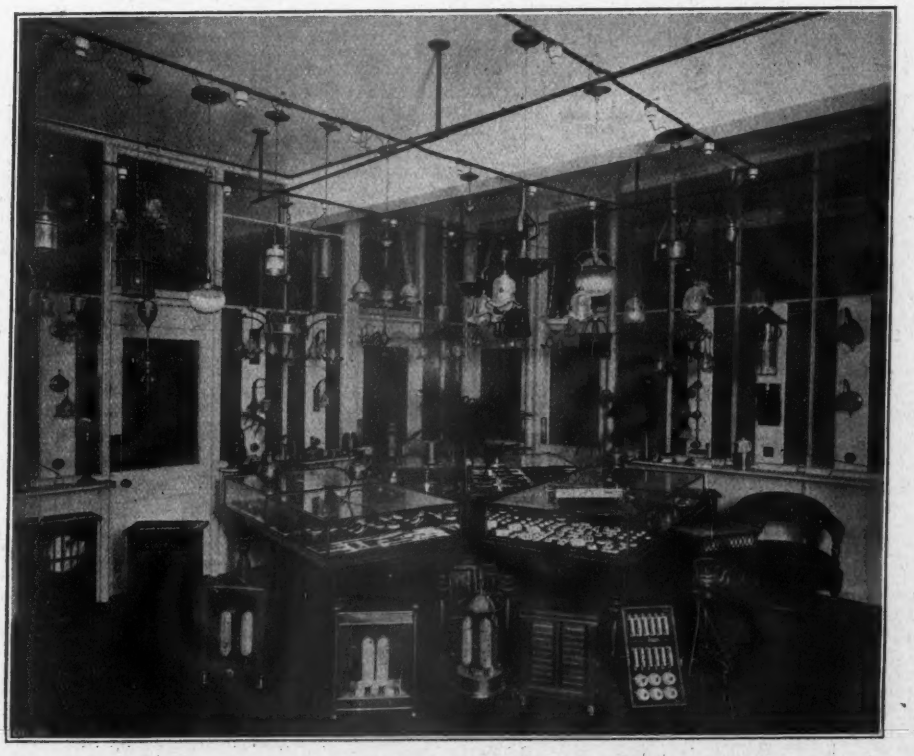
F.—Common wire for system E with four-wire distribution.

The device, which is patented, will, we feel sure, be much valued by engineers, and would be more so if more substantially made.

Another slide rule, also just received, is a 6-in. card miniature in a case, which Messrs. Marples, Leach & Co., of 6, Victoria Avenue, Bishopsgate Street Without, E.C., have forwarded. Although not so elaborate as the one described above, it is a very neat little memento, and any reader who cares to obtain one has only to drop a postcard to the firm.



Messrs. Callender's Slide Rule for Determining Cable Areas.



View in the New Showrooms of Messrs. Simplex Conduits, Ltd.

The systems of supply for which the rule is applicable are:—

A.—Two or three-wire D.C., or one-phase A.C.

B.—Common return in two-phase three-wire system.

C.—Three-phase, two-phase, and neutral of three-wire system A.

D.—Three-phase common return when volts have been given between outers, with four-wire distribution.

E.—Three-phase (star winding) outers when volts are given between an outer and the central point.

SIMPLEX NEW SHOWROOMS.

In keeping with that spirit of enterprise that has long characterised the doings of Messrs. Simplex Conduits, Ltd., the firm has just struck out afresh in a very commendable manner in the London district by opening up a fine showroom, offices and conduit stores

at 115, Charing Cross Road, W.C. The doings of few companies are better known to the trade than are those of this company, and for a detailed description of the factory at Garrison Lane, Birmingham, we may refer our readers to the Electrical Review for November 9th, 1906.

The new London branch is housed in the ground floor and basement of a fine recently-erected building, which stands in a commanding position. It comprises the sales department, which deals with local and South of England requirements generally, and the publicity department. The offices are situated on the ground floor, surrounding and opening into the showroom.

The basement is devoted to store purposes. Larger stocks than hitherto can now be carried (approximately 150,000 ft.), and with a view to increasing facilities in this direction the company have excavated a portion an extra 3 ft. in depth, in order that tubes may be stored upright. The extra quantity which can be stowed away in this manner, as compared with the horizontal rack method which has to be resorted to when it is not possible to obtain 14 ft. head room, is enormous. Fittings are stocked in the usual form of bins. Ample provision is made for rapid packing and despatch, whilst a small work bench is fitted up with drill, vice, screwing apparatus, &c., to facilitate the carrying out of these operations on the spot in the case of urgent orders.

The showroom is equipped with every description of accessory, displayed in a number of glass show cases. The main example of the conduit system is, however, given by the lighting installation of the premises, which has been carried out by the company's own men with a view to showing, as far as possible, typical examples of how things should be done. Especially is this noticeable at the main lighting board controlling the ground floor. The whole of the various runs are brought to a point on the ceiling above the board, and collected in an adaptable box, from which the circuits are taken down to the board in four tubes. The board itself is of the D.P. fuse and S.P. switch, wood cased type. The fuses are of Simplex special enclosed cartridge pattern mounted on separate slate bases, and controlled by "rapid action" switches. Another interesting piece of work is to be seen in the basement, where the supply company's mains enter the building. Two main fuseboards of different pattern are installed, one serving to control the power supply, and the second the basement lighting. The main switches and fuses are of the Simplex "push on pull off" type of combined switch fuse.

In the general equipment and arrangement of the showroom flexibility has been the great aim, that is, to facilitate rearrangement of the various samples and fixtures displayed. It is anticipated that an entirely fresh appearance can be given to the showroom within an hour or so. No apparatus is permanently fixed in position, a circumstance which has been considerably assisted, if not rendered necessary, by the nature of the building itself. It happens to be built entirely throughout on the L.C.C. regulations, which in many respects are peculiar. Thus, the ceiling of the showroom is of concrete 1 ft. thick, with an iron girder every 6 in., in addition to which there are two 18 in. ×12 in. girders supporting and projecting from the ceiling. To attach electric fittings to this would naturally have entailed a tremendous amount of labour and cutting away. The difficulty has been obviated by fixing three parallel lengths of ¾ in. Simplex conduit hung 20 in. below the ceiling, so as to clear the girders above referred to, and 7 ft. apart. Across these are laid at right angles several runs of ¾ in. conduit, along which are placed wall sockets mounted on flange couplings. These runs are wired up in two sections to a two-pin plug at each end.

All types of electric light pendants and electroliers are attached to the cross tubes. They are wired complete to a plug, so that they can be readily put into circuit by connection to one of the sockets The plugs at the two ends of the circuit wires of the tubes are carried down the partitions to another wall socket fixed on a small shelf, which surrounds the showroom at a convenient height. The wall socket is wired directly from the main distribution board.

It will be seen that half a dozen fittings can be thus readily lighted up for display purposes, whilst, if it is desired to have one only lighted in order to obtain a better idea of its effect, this is easily accomplished by disconnecting the other fittings from the sockets in the same overhead run. As all pendants are attached by S hooks, their position can be altered in a few moments. Brackets and wall fittings are attached to wood panels fixed in the lower frames of the partitions; these panels are all interchangeable, and are arranged so that they can be readily removed and altered. Brackets, &c., are also wired to plugs for connection to the sockets on the shelf before mentioned.

The arrangement of the windows is carried out on a similar plan. Every piece of lighting or heating apparatus is fixed with a plug for connection to a socket. The latter are arranged in groups of eight flush sunk in Simplex cast-iron boxes and controlled directly from the main board.

In addition to the well-known tubes, accessories, and distribution boards manufactured by Simplex Conduits, Ltd., there is quite a representative display of electric lighting fixtures, heating and cooking apparatus, lamps, cables. Some of the designs are quite original and tasteful, whilst an innovation is to be found in some "pedestal" form of luminous radiators, and one for use on the wall. The cables are British-made throughout.

Those interested might find it well worth while to pay a visit to the above premises.

In the evening of Tuesday last week, we had the pleasure of attending the formal opening of the premises. Later a company of consulting electrical engineers, central station engineers and contractors, together with the Simplex branch representatives and agents, were the guests of the company at a dinner and concert held at the Holborn Restaurant. The chairman, Mr. Henry Huggins, presided, and proposed the toast of "Our Guests," to which Mr. J. E. Lloyd-Barnes, M.I.M.E., of Liverpool, responded, congratulating the company upon the success that had attended their operations. He said that they had done a great deal to further the development of the electrical industry, particularly on its distributive side, and he understood that Mr. Waterhouse was now going in for cables. Mr. C. S. Northcote proposed the toast of "The Technical Press," in a few characteristic sentences. Mr. A. Lester Taylor proposed "The Company," and speaking as electrical adviser to two of the largest fire insurance companies, stated that conduit wiring with suitable accessories was the best and safest that it was practicable to adopt. The simplicity of the open-seam system, and the great advantages of the socket joint, with his actual experience of its security, strongly impressed him in its favour, and it had been standardised by the Engineering Standards Committee. Mr. L. M. Waterhouse, M.I.E.E., responded.

BUSINESS NOTES.

Consular Notes.—Brazil.—In a recent report on the trade of Brazil, the Austro-Hungarian Consul at Rio de Janeiro states that there has been a wonderful extension in the electro-technical world in Brazil during recent years, owing, to a great extent, to the wealth of water powers available for electrical purposes in the country. In the Federal Capital, in consequence of a treaty between the municipality and Engineer Reid, the Rio de Janeiro Tramway Lighting and Power Co., an Americo-Canadian Co., possess a monopoly for the supply of electric power for public purposes and for electric lighting, and have obtained possession of the tramway system and the funicular railway on the Corcovado. Moreover, the company named have secured the telephone system of the town. The chief power station is situated at a distance of 12 miles from the town Pirahy, on the waterfalls of the Pirahy River (a tributory of the Parahyte) in the district of Santa Roza. This station produces 25,000 H.P. A line 22 km. long connects the power station with the Central Railway, whilst a small gauge line 4 km. long connects the power station with the falls. These works will be shortly completed and power carried to Rio de Janeiro, when electric traction will be installed on the tramway system. The extension of the lines and the present bad condition of the system will add greatly to the difficulties, and it will be some considerable time before the whole work is completed. The Compania Ferro Carril do Jardin Botanico possesses its own electrical works for traction purposes on the railway, as does also the tramway company of Nitheroy, on the other shore of the bay; the works for the latter were executed by the firm of Guinle & Co. As regards other large electrical undertakings, the Bahia Tram, Light and Power Co., a sister company to the Rio de Janeiro Tram, Light and Power Co., may be mentioned. This company is engaged in the construction and exploitation of tramways and the supply of gas, electric light and electric power in Bahia and district by the aid of Americo-Canadian capital. For this purpose the company has taken over the Carris Electric Tramway. This tramway serves the port and the business quarter of Bahia and the suburb Itazipe, and has a length of 15 km. The company holds a concession until 1973, and has the monopoly for the construction of tramways within 500 metres on both sides of its line. It has also bought up the Cie. d'Eclairage de Bahia, a Belgian company with a concession up to the year 1950 for the production and sale of gas and electric power. In consequence of the anticipated necessary extension of the electric plant, the company has contracted with Messrs. Dick, Kerr & Co., Ltd., for the construction of a large electric power station, and in connection therewith has secured the rights to the valuable falls of the River Jequirica, about 45 miles from the town, with a drop of 54 metres, and giving some 10,000 H.P., as well as to the Falls of Santarem, 20 miles south of Bahia on the sea coast. Another greater water-power, that of the Falls of Tymbora on the River Paragnassu (30,000 KW.) has been purchased by the firm Guinle & Co., which also possesses a tramway in Bahia, and is the competitor of the above-named company. Numerous other undertakings have also been inaugurated in the other towns of Brazil. The delivery of materials and machinery is almost entirely in the hands of the North American firms, but German and British houses also compete, and as will be well understood, there is a great opening for trade in these lines. There can be no doubt that with the opening up of the interior, which is rapidly taking place, much greater development will be made, and electrical firms should keep a keen watch on the market.

Ferro-Concrete.—We understand that the Mouchel system of ferro-concrete is being largely employed for the foundations of engineering structures in all parts of the country, among recent contracts being foundations for the Bristol Corporation electricity station at Avonmouth.

International Boiler-Tube Combination.—A Reuter telegram from Paris states that an international arrangement between boiler-tube manufacturers has been signed. Among the parties to the agreement are the British, German, Belgian and American manufacturers. The French manufacturers have not yet signed the agreement.

A Good Example.—The Brush Electrical Engineering Co.'s employés have contributed £250 to the funds of the Loughborough General Hospital.

Capital Reduction.—Triumph Stoker, Ltd.—The capital of this company has been reduced from £6,000 to £3,000, in 10s. shares.

Trade Statistics of British India, 1906-7.—The following statistics showing the importation of electrical and other materials into India during the year ended March 31st, 1907, are taken from the official trade statistics recently issued, the figures for 1905-6 being added for the purpose of comparison:—

	1905-6. Rupees.	1906-7. Rupees.	Increase or decrease. Rupees.
Lampware:—			
From United Kingdom ...	7.81.171	8.94.386	+1.13.215
„ Germany	3.04.086	5.22.012	+2.17.926
„ Austria-Hungary ...	4.77.727	5.82.842	+1.05.115
„ Other countries ...	1.89.189	3.56.798	+1.67.609
Total	17.52.173	23.56.038	+6.03.865
Copper:—			
From United Kingdom ...	98.48.953	88.93.417	−9.55.536
„ Germany	22.00.678	36.50.031	+14.49.353
„ Belgium	4.29.097	4.59.580	+ 30.483
„ Austria-Hungary ...	2.62.386	1.64.100	− 98.286
„ United States ...	1.09.065	14.675	− 94.390
„ Other countries ...	14.97.246	7.49.741	− 7.47.505
Total	1.43.47.425	1.39.31.544	− 4.15.881
Electrical Machinery:—			
From United Kingdom ...	21.47.657	23.13.974	+1.66.317
„ Germany	56.681	93.242	+36.561
„ Belgium	51.243	90.140	+38.897
„ France	5 870	21.277	+15.407
„ Italy	2.329	42.705	+40.376
„ United States ...	1.11.721	1.31.000	+19.279
„ Other countries ...	2.799	11.749	+ 8.950
Total	23.78.300	27.04.087	+2 25.787
Mining Machinery:—			
From United Kingdom ...	7.30.760	5.94.973	−1.35.787
„ Germany	—	2.130	+ 2.130
„ Belgium	4.585	4.670	+ 85
„ United States ...	5.790	19.370	+ 13.580
„ Other countries ...	4.754	—	− 4.754
Total	7.45.889	6.21.143	−1.24.746
Steam Engines and Parts: Locomotives other than Railway:—			
From United Kingdom ...	1.94.579	5.65.301	+3.70.722
„ Germany	19.722	93.489	+ 73.767
„ Other countries ...	2.325	11.615	+ 9.290
Total	2.16.626	6.70.405	+4.53.779
Other Sorts of Steam Engines:—			
From United Kingdom ...	92.55.880	1.20.77.042	+28.21.162
„ Germany	1 56.022	17.266	−1.38.756
„ Belgium	71.960	1.31.226	+ 59.266
„ United States ...	2.04.883	1.23.402	− 81.481
„ Other countries ...	1.28.851	94.073	− 34.778
Total	98.17.596	1.24.43.009	+26.25.413
Rails:—			
From United Kingdom ...	23.22.767	83.49.538	+60.26.771
„ Belgium	1.87.690	4.18.216	+ 2.30.526
„ Other countries ...	1.242	3.422	+ 2.180
Total	25.11.699	87.71.176	+62.59.477
Electrical Instruments, Apparatus, &c.:—			
From United Kingdom ...	27.47.673	44.49.170	+17.01.497
„ Germany	1.19.235	4.20.889	+ 3.01.654
„ Belgium	1.16.246	2.54.007	+ 1.37.761
„ France	14.183	1.384	− 12.799
„ Italy	5.972	23.197	+ 17.225
„ Austria-Hungary ...	14.782	4.934	− 9.848
„ United States ...	65.749	4.16.735	+ 3.50.986
„ Other countries ...	2.179	7.561	+ 5.382
Total	30.86.019	55.77.877	+24.91.858
Materials for Construction of Telegraphs:—			
From United Kingdom ...	365	1.47.197	+ 1.46.832
„ Other countries ...	—	1.278	+ 1.278
Total	365	1.48.475	+ 1.48.110

In addition to the above, the following statement shows the imports of Government stores, admitted free of duty:—

Copper:—			
From United Kingdom ...	12.99.997	22.37.068	+9.37.071
„ Germany	—	2.56.455	+2.56.455
„ Australia	16.20.918	18.84.230	+2.63.312
„ Other countries ...	14.344	1.14.148	+ 99.804
Total	29.35.259	44.91.9013	+15.56.642
Rails:—			
From United Kingdom ...	1.34.21.206	77.28.740	−56.92 466
„ United States ...	2.23.751	—	− 2.23.751
„ Other countries ...	25.537	6.587	− 18.950
Total	1.36.70.494	77.35.327	−59.35.167
Materials for Construction of Telegraphs:—			
From United Kingdom ...	13.67.820	27.86.870	+14.19.050
„ Other countries ...	1.525	4.215	+8 2.690
Total	13.69.345	27.91.085	+14.21.740
Instruments and Appliances (includes electrical):—			
From United Kingdom ...	17.25.974	13,99.459	− 3.26.515
„ Other countries ...	12.709	15.353	+ 2.644
Total	17.38.683	14.14.812	− 3.23.871
Machinery and Millwork:—			
From United Kingdom ...	29.42.196	32.94.779	+ 3.52.583
„ Other countries ...	30.648	14.729	− 15,919
Total	29.72.844	33.09.508	+ 3.36.664

New Zealand.—The New Zealand Customs authorities have given a decision to the effect that the duty to be imposed on electric motors of British manufacture is 10 per cent. *ad valorem*; those of foreign construction are at present dutiable at the same rate, but after March 31st, 1908, at 15 per cent. *ad valorem*.

Calendars and Catalogues.—Once again we are indebted to Messrs. Siemens Bros. & Co., Ltd., and Siemens Bros. Dynamo Works for a very acceptable pocket diary for the New Year. In addition to the daily diary spaces there is ample provision at the end for note-making. The insurance coupon is not likely to be overlooked by the recipient, and the pages of information concerning wire gauges, tables of conductors, weights and measures, &c., are handy for reference.

The Electrical Construction Co., Ltd., Wolverhampton, have sent us two celluloid pen-holders, with which we shall write better during at any rate part of 1908, and in their very neat and handy pocket case we shall be able to take note of every brilliant thought for the electrical trade that strikes us.

Messrs. Venner & Co., of Westminster, have favoured us with one of the nicest things in the way of desk calendars. It is of very pleasing design in art metal work, bearing the words, "East, West, Hame's Best," with two interesting little old-time figures, looking through an open casement toward a golden sunset sky whereon is written the fact that Venners are vendors of meters and time switches.

Messrs. Mather Bros., electric light and power engineers, &c., 36, Farringdon Street, E.C.—A hanging calendar for 1908 has been received from this firm with monthly sheets, on each of which appears a complete calendar for the year.

Messrs. Mavor & Coulson, Ltd., Glasgow.—Leaflet showing electrical haulage gears, with inquiry form; and Pick-Quick coal-cutter card for December, with instructions for turning the machine.

Brush Electrical Engineering Co., Ltd., Loughborough.—A very neat little waistcoat pocket diary and note book, bound in morocco leather, with £1,000 accident coupon and back-loop pencil.

Messrs. Badshawe & Co., Ltd., Dunstable Works, Dunstable.—Leaflets relating to elevating and conveying machinery of various types.

Messrs. Geipel & Lange, Vulcan Works, St. Thomas Street, S.E.—Waistcoat pocket diary, with £1,000 insurance policy, pencil, and engineering tables selected by Mr. Geipel.

Messrs. Andrew & Suter, 23, Goswell Road, E.C.—Part I of their electrical measuring instruments catalogue, dealing with ampere and voltmeters, portable sets, &c., of various patterns, made by Messrs. Keiser & Schmidt, of Berlin, for whom they are the sole selling agents.

A very neat vest pocket diary and engagement book for the new year has been received from Messrs. Johnson & Phillips, Ltd. It is in the same pleasing style as last year—dark green cover, with gilt lettering and edging. Any member of the electrical trade can obtain a copy by applying to the firm.

The Langdon-Davies Motor Co., Ltd., Southwark Works, Deverell Street, London, S.E.—New catalogue, comprising a number of illustrated sheets of some of their new types of electric motors, single, two and three-phase A.C., small domestic D.C. motors, friction clutch motors, horse-power meters for A.C. motors, spur reduction gear, no-volt and overload release starting apparatus and electric fans. A separate publication illustrates by half-tones a number of applications of the motors in driving different classes of machinery.

Messrs. Drake & Gorham, Ltd., 66, Victoria Street, Westminster, S.W.—A very fine catalogue of 280 odd pages, with thumb index to the various sections. We have also received a separately bound copy (stiff paper cover in grey) of each of these sections, and if we enumerate these and their titles the reader will obtain an idea of the very wide ground covered by the firm:—*Section A*—boilers, steam, gas and oil engines, producer gas plant, turbines and engine room stores; *Section B*—shafting, pulleys, belting, &c.; *Section C*—dynamos and motors, switchboards, switchgear, measuring instruments and accessories; *Section D*—storage batteries and accessories; *Section E*—wires, cables and accessories for lighting and power transmission, telephone, bell and other work, also lightning conductors; *Section F*—incandescent and arc lamps, carbon, tantalum and Nernst lamps, switches, wall plugs, fittings, casing, conduits and accessories; *Section G*—electric bells, telephones, speaking tubes, electric heating appliances, electric fans; *Section H*—motor-driven appliances (pumps, fire appliances, circular saws, dairy machinery, chaff cutters, and so on), also the firm's latest department—motor-cars. The work must have taken a great deal of compiling, and to many a firm it must be of considerable service and value. In addition to descriptive matter concerning and prices of the manufactures themselves, there are general articles of interest concerning them and their purposes, as well as a number of line diagrams and some half-tone views of plants installed by the firm.

Messrs. Veritys, Ltd., London, Manchester, &c.—Several new publications have just been issued. No. 561 is a catalogue of about 60 pages, illustrating, describing briefly, and pricing a variety of electrical accessories, such as fuse and distribution boards, branch switches, "Diamond H" switches, "De Luxe" ceiling roses, flush switch panels, cut-outs, wall plugs and so forth. Leaflet No. 569 gives prices and particulars up-to-date of carbons for open, enclosed and flame lamps, and No. 575 contains illustrated information concerning, and prices of, the "Astonlite" tubular system for lighting shop windows, show cases and the like.

Hart Accumulator Co., Ltd., Marshgate Lane, Stratford, E.—Once again we are favoured by this company with a desk blotting pad with top pocket. With this we shall be constantly reminded for some time to come of the 500,000 cells in use, and of non-corrosive terminals.

Book Notices.—*Hazell's Annual* for 1908 has been issued by Messrs. Hazell, Watson & Viney, Ltd., of 52, Long Acre, W.C. 3s. 6d. net.—The contents have been revised up to December 2nd, 1907, and a strong feature of the book is its complete index. *Hazell's* has for so many years been a useful reference companion for the study and the office, that it may be sure of having a good reception now that it has reached its twenty-third edition. We have ourselves frequently found it of service in hunting up references. As it claims to be so it is, a cyclopædic record of men and affairs, which during 1908 will be found indispensable by many men and women.

"Annuaire pour l'An 1908 publié par le Bureau des Longitudes." Paris: Gauthier-Villars. Price 1 fr. 50 c.

"English Prices with French Equivalents." By H. P. McCartney. London: E. & F. N. Spon, Ltd. 1907. Price 1s. net.

"The Slide Rule." By R. G. Blaine. London: E. & F. N. Spon, Ltd. 1907. Price 2s. 6d.

"Electric Railways Theoretically and Practically Treated." By S. W. Ashe. Vol. II. London: A. Constable & Co., Ltd. 1907. Price 10s. 6d. net.

Bankruptcy Proceedings.—C. W. Stafford, electrical engineer, Ocker Hill, Tipton.—A first and final dividend of 4s. 4d. in the £ was payable December 24th. Official Receiver's offices, 199, Wolverhampton Street, Dudley.

Andrew Matson, electrical engineer, Stockton-on-Tees.—A first and final dividend of 1s. 5½d. is payable December 28th. Official Receiver's office, 8, Albert Road, Middlesbrough.

Liquidation.—United States Power Syndicate, Ltd.—This company is winding up voluntarily with Mr. T. E. Shuttleworth, Royal Insurance Buildings, Church Street, Sheffield, as liquidator.

Christmas Holidays.—The Union Electric Co.'s offices, works and stores are closed for the holidays until Monday, 30th inst.

Trade Announcements.—The Electric & Ordnance Accessories Co., Ltd., ask us to correct an error that crept into their advertisement of last week. Though Messrs. Baxter and Caunter are their London agents for the majority of their lines, this does not apply to motor business, this particular agency being held by the Sloan Electrical Co., Ltd., of 15, Fore Street Avenue, London, E.C.

Messrs. Johnson & Phillips, Ltd., ask us to announce that the agreement with Messrs. Welding & Co., of 64, Stanley Street, Liverpool, and 283, Deansgate, Manchester, to represent them in the Counties of Lancashire and Cheshire, has been terminated. All inquiries and orders should be sent to the firm direct at Victoria Works, Charlton.

From January 1st the head office of Messrs. Morris-Hawkins, Ltd., will be at their works at Dagenham, Essex.

Messrs. Rumney & Rumney have removed to more convenient premises at 125, Strand, W.C.

The Wellman-Seaver-Morgan Co., Ltd., announce that they have decided to bring the name of their managing director into the title of the company, which will in future be called "Messrs. Wellman, Seaver & Head, Ltd." The name of Morgan (after Mr. T. R. Morgan, who died two years ago) has, they find, led to their being confused with other concerns of that name with which they have no connection. The firm have recently formed a special furnace department and also an electrical department for dealing with their special controllers and brakes.

The Electric and General Stores Co., Commercial Chambers, 104, Albion Street, Leeds, inform us that they have been appointed sole selling agents for the County of Yorkshire, to Messrs. The Union Electric Co., Ltd., of London, for their well-known "Excello" flame arc lamps, and other arc lamps, motors, dynamos, switchgear, instruments, &c.

The Armorduct Manufacturing Co., Ltd., inform us that they have recently purchased the patent obtained by Mr. H. C. Pearson, of Manchester, for his grip conduit fitting, which provides for electrical continuity, and will shortly place this device upon the market. Mr. F. Smart, who was for many years connected with the General Electric Co.'s Newcastle branch as assistant manager, has been appointed manager of the Armorduct Company's Newcastle branch.

Venice Exhibition.—Some time ago, at the Venice Exhibition, the selection of Ediswan apparatus and lamps received the Royal commendation. The exhibiting firm, Messrs. Rossetto and Romanin, have since received a Gold Medal and Diploma for their stand of "Ediswan material."

Entertainments, &c.—On 19th inst. the Paisley Tramwaymen's Christmas Social was held in the Hall at Elderslie, which was seasonably decorated for the occasion, and an enjoyable programme was carried out. A sketch entitled "The £500 Prize," by members of the tramway staff was much applauded. The distribution of prizes for the various competitions which have been held during the past two months took place; the prizes numbered over 50. In the course of the evening Mr. Fred Coutts, general manager, presented Mr. Matthew Sillars with a handsome lounge chair as an acknowledgment from the employés of his services in connection with the Men's Social Club.

The members of the drawing-office staff of Messrs Thos. Parker, Ltd., have held their annual dinner at the Vine Hotel, Wolverhampton, a very successful evening being subsequently devoted to music.

Dr. Martin Berry's (Bloxwich) Concert Party gave a concert at the Walsall Corporation Hall, on behalf of the Tramway Employés' Social Club, on Friday evening last, a capital programme of vocal and instrumental music being submitted.

LIGHTING and POWER NOTES.

Beckenham.—A L.G.B. inquiry has been held into the application of the U.D.C. for sanction to borrow £16,000 for the purpose of extending the electrical lighting works and laying down additional machinery. There was no opposition.

Bury.—It has been decided by the T.C. to erect new electricity works at Chamber Hall for supplying electricity on the H.T. alternating system. The initial capital expenditure is estimated at £70,000, exclusive of land and coaling facilities, and a further £15,000, it is estimated, will be required for plant to supply alternating current to large consumers.

Canada. — The Toronto Board of Control has rejected the offer from the Toronto Electric Light Co. to lease or purchase the company's undertaking, preferring the Hydro-Electric Power Commission's offer. A power-gas company, in a letter to the Mayor of Toronto, affirms that 22 local manufacturers saved $41·23 per H.P. per annum by substituting gas engines for electric motors, the average cost of the gas power being $18·27 per H.P. actually used The Power Commission's estimate for power is $17·85 per H.P., but the city would have to expend 2½ million dols. on a distribution plant, and the power gas company urge that on these figures it would be better to develop the manufacture of producer gas than extend the use of electricity.

Haslingden.—Following the recommendation of the Electricity Committee, the T.C. on December 19th decided to take over and run the existing steam trams from the end of the year to April 1st; on April 1st to commence the work of converting the system to electricity; to generate its own electricity; and to appoint Messrs. Handcock & Dykes, whom it had consulted before arriving at these decisions, as consulting engineers to the Corporation. The decision to generate its own electricity has led to a good deal of criticism, and replying to this, Alderman Barlow, chairman of the Electricity Committee, pointed out that although it had negotiated with the Lancashire Electric Power Co. since 1902, it was not until July this year that it was told that this company could not supply. The Committee had come to the conclusion that if it did not generate its own electricity it would have to pay much more for it. Accrington's Act of Parliament forbade it selling Haslingden any electricity; Rawtenstall could supply, but its price was far above what Haslingden could make its own electricity for.

(*Continued on page* 1059.)

THE SERIES LUMINOUS-ARC RECTIFIER SYSTEM.

By H. LANSDELL HOWARD.

The remarkable success and rapid development of the series luminous-arc rectifier system in the United States has been the cause of much comment among electrical engineers of that country. Two and a half years ago a purely experimental installation was attempted; to-day 65 cities or towns employ the system almost entirely, while 18,000 lamps are in use. In every case in which it has superseded any of the older methods of arc lighting a very satisfactory saving has been effected in cost of operation and maintenance, and balance-sheets show a substantial profit; doubtless, therefore, the following details will be found of great interest to European readers.

Now that high-tension overhead transmission is becoming more and more popular in England, the advantages of a system in which it is possible to use direct current at a pressure of 4,500 volts in the case of the 50-light rectifier sets, and 6,600 volts with the 75-light sets, with lamps working in series, will be keenly appreciated by all who are interested in electric lighting—partly, perhaps, since it is the means of reducing the amount of copper necessary for installation to a minimum and very greatly reducing resistance losses. To take the place of the synchronous motor and Brush arc dynamo, which for several years have been the usual machines used to work the series direct-current arc lighting system, there is used a set consisting of a constant-current transformer, a small exciting transformer for starting purposes, a reactance and a mercury rectifier tube, with some appliance for keeping it cool when in operation, such as a motor-driven blower, or in sets of the latest design, a tank filled with oil, which is cooled by pipes through which water is kept circulating, and in which the rectifier tube is immersed. All air is exhausted from the tube, the shape of which may be seen from the sketch* in the wiring diagram (fig. 4, p. 1056); A is a condensing chamber, B and C are the anodes or positive electrodes, D the cathode or negative electrode, and E and F the electrodes used for starting the arc.

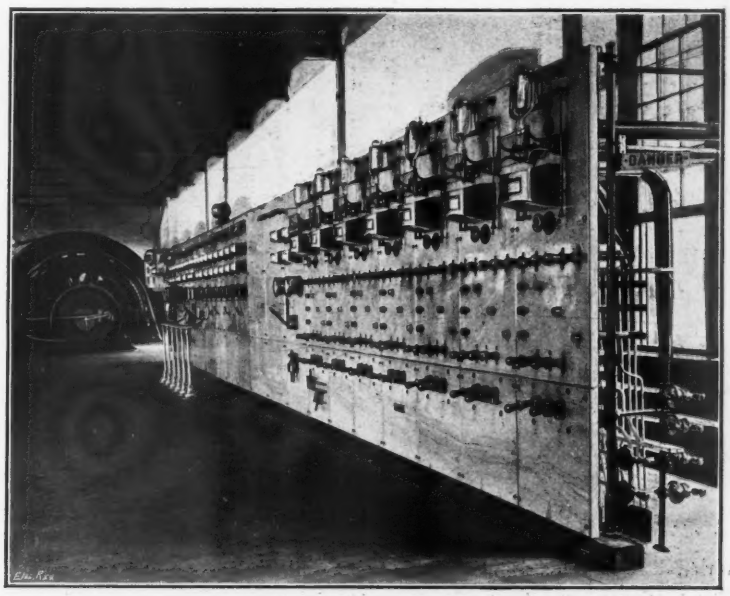


Fig. 1.—Switchboard with Mercury Rectifiers Fitted.

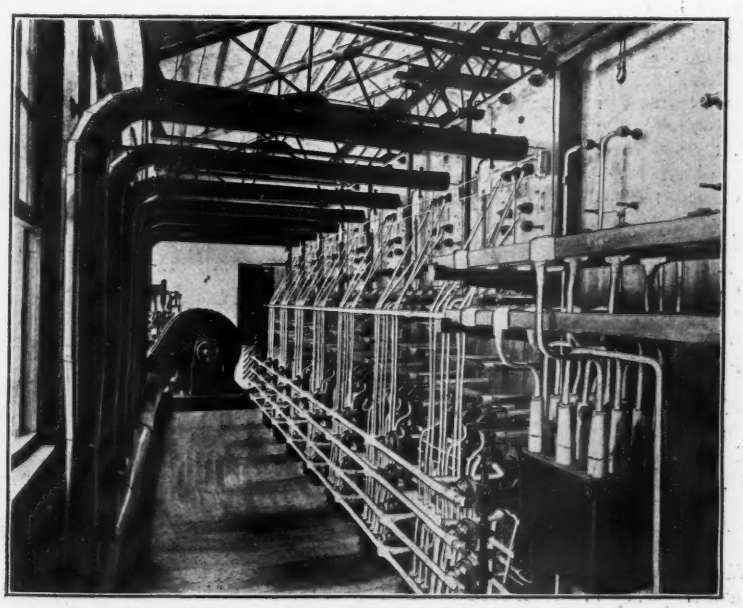


Fig. 2.—Rear of Switchboard, showing Air-Blast Apparatus.

E and F are connected to a small starting transformer, the primary of which is connected to the low potential 'buses used for operating the blower motor, the branches E, F and D forming a small rectifier working on short-circuit. The lower tubes E, F and D contain enough mercury to overflow from one tube to another, and so make the necessary initial contact to start an arc when the rectifier tube is slightly shaken.

The arc between the two starting electrodes E and F and the negative electrode D ionises the mercury vapour, and on applying voltage to B and C, an arc to D through vapour is at once established. When the current at B is at its highest positive value, it is at its lowest negative value at C, B and C being connected to the two opposite ends of the secondary of

* See also Electrical Review, December 13th, page 995, fig. 4.

the current transformer. The arc being established between B and D in the half-cycle during which B is positive, the current flows from B to D, and from D to the load. When the current at B is about to change from low positive to low negative value, the arc between B and D tends to reverse its polarity, but encounters great resistance to its flow in the

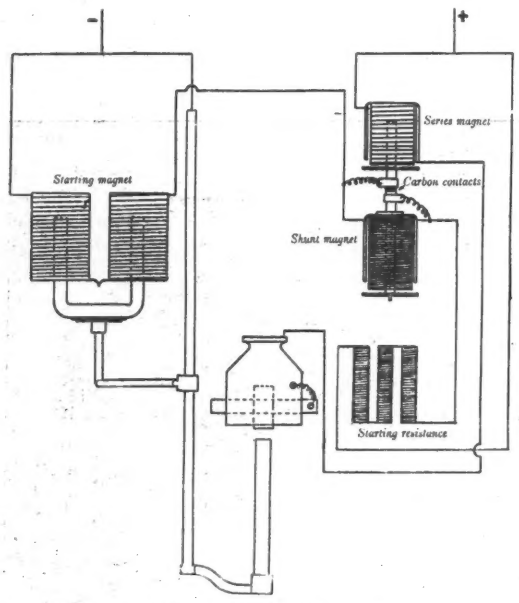


FIG. 3.—DIAGRAM OF LAMP CONNECTIONS.

reversed direction, on account of the fact that while the iron-mercury rectifier is a good conductor of current flowing in one direction, it offers great resistance to the reversed flow when the polarity is changed.

C being now positive, the current finds an easier path and swings over from B to C, establishing itself between C and D, thus keeping D negative and the current flowing from D always unidirectional. Even at very high frequencies the arc would go out when the alternating current wave was at zero value, owing to the negative cathode losing its excitation, but, on account of the reactance discharging, enough voltage is supplied to maintain the arc, and at the same time to smooth out the pulsations of the rectified current. With the mercury arc rectifier and suitable reactances it is possible to produce a direct current with pulsations of exceedingly small amplitude, smaller, in fact, than those of a current collected from the commutator of a direct-current generator; this fact makes the use of current rectified by this system very successful for telephone operation, and it has superseded direct-current machines in, for instance, the towns of Hackensack, N.Y.; Perth Amboy, N.Y.; and Ypsilante, Michigan, and in about 200 other stations. The tap on the primary of the constant-current transformer is used when the load happens to be lower, and decreases the exciting current, thus bringing up the power factor and efficiency.

Poughkeepsie Installation.—In the town of Poughkeepsie, New York State, America, the mercury arc rectifier has been used for about two years, this place being one of the first to be equipped with the system, and everything has been running satisfactorily from the beginning, not one breakdown, necessitating the use of an extra set which was installed for emergencies, having occurred.

The Equipment of Poughkeepsie Station.—Two-phase alternating current at a voltage of 2,300 and frequency of 60 cycles is supplied by one 1,000-KW. Curtis vertical type turbo-generator, made by the General Electric Co., of America, and two 400-KW. alternators made by the same firm, one direct-coupled and one belt-driven by two horizontal Corliss type engines.

The exciter plant consists of one 125-volt, 40-KW. generator driven by a two-phase induction motor. The alternators are all run in parallel, and the current generated is supplied partly to transformers which step up to 13,600 volts, supplying current to the opposite side of the Hudson River by means of submerged cables, partly to transformers which step down the voltage from 2,300 volts to 440 volts for conversion to direct current for use on the street railway system by means of one 300-KW. and one 200-KW. rotary converter, the rest being used for the motor load, incandescent lighting and rectifiers.

To facilitate any changes or repairs being made in the daytime, the bus-bars of the rectifier panels are connected through an oil switch to the main 2,300-volt bars.

There are seven mercury rectifier sets; six supply six circuits with direct current, the seventh set being transferable

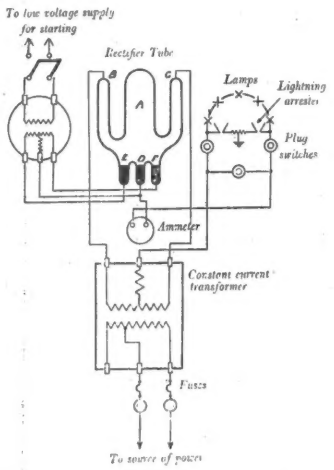
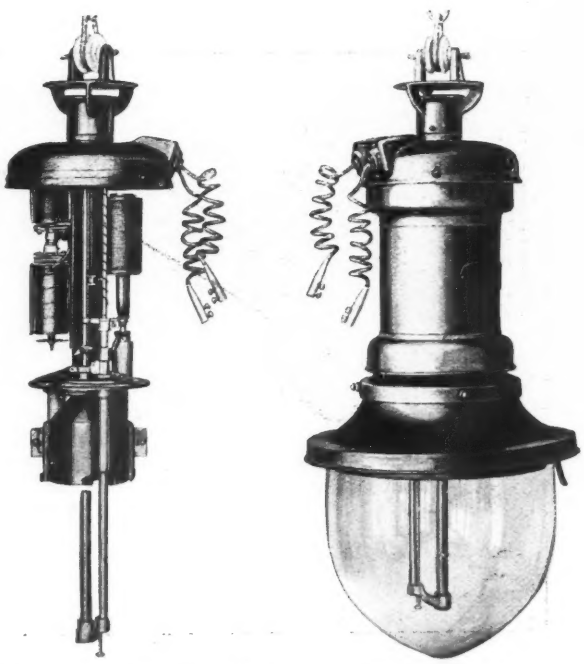


FIG. 4.—CONNECTIONS OF RECTIFIER AND LAMP CIRCUIT.

to any circuit, by means of transfer 'buses and plug switches, in case of accident or breakdown to the transformers or reactance of that circuit. In case of a rectifier tube becoming destroyed, either on account of accident or age, a new tube can be connected in place of the damaged one in a few minutes.



FIGS. 5 AND 6.—VIEWS OF MAGNETITE LAMP.

The method of keeping the tubes cool when under load is, in this station, by air supplied by a motor-driven blower to a main pipe, which runs along the back of the switchboard, having smaller pipes leading out of it to holes drilled directly behind the tubes. This gives a good blast of cool air

upon the glass bulbs, and, though not so efficient as the newer method of oil cooling, works satisfactorily. A glance at the views of the front and back of the switchboard, figs. 1 and 2, will show the positions of the ventilating holes relative to the tubes, and the piping.

The light is supplied by magnetite lamps made by the General Electric Co., of America, and on each of the six circuits there are respectively 54, 54, 56, 48, 56 and 56 lamps—324 in all—illuminating streets over a total of 54 miles, the average total load taken by the six rectifiers being about 110 KW. Each lamp takes 4 amperes at a pressure of about 80 volts. The average life of rectifier tubes is about 1,000 hours, while the record in this particular station is as much as 1,200. Tubes under test at the makers' works have been still in good condition after having been run continuously for over 2,000 hours.

The outside feeder cables, well insulated, are carried on poles, the lamps being about 25 ft. above the street. A diagram of the internal connections of the magnetite lamp is given in fig. 3.

On starting the lamp the current first goes through the starting magnet and the carbon contacts of the series and shunt magnets. The starting magnet being energised lifts the negative electrode till it touches the positive; the current will then go through the positive and negative electrodes and through the series magnet coil. The series magnet is then lifted and breaks contact with the shunt magnet, and thus cuts the starting magnet from the series circuit. It will be seen that it is then on the shunt circuit in series with the shunt magnet coil and starting resistance, consequently it becomes greatly demagnetised, the feeding magnets drop and with them the negative electrode, thus drawing the arc. A clutch automatically operates and holds the lower electrode at the correct distance from the upper.

As the negative electrode is consumed, the voltage necessary to maintain the arc becomes higher and the shunt magnet will become sufficiently energised to make contact between the shunt and series magnet contacts. The starting magnet is again in the series circuit and lifts the lower (negative) electrode till it touches the upper (positive), so that the conditions are the same as at starting and the whole operation is repeated. Draught through a ventilating device above the positive electrode helps to keep the arc steady and in correct relative position with regard to the negative electrode. An automatic cut-out is also contained in the lamp, preventing injury in case of complete consumption or breakage of the electrodes. Near the arc a small reflector, designed to throw light at an angle of about 10° below the horizontal, is fitted, and to obtain evenness of light distribution in the vicinity of the lamp the lower part of the globe is sand-blasted.

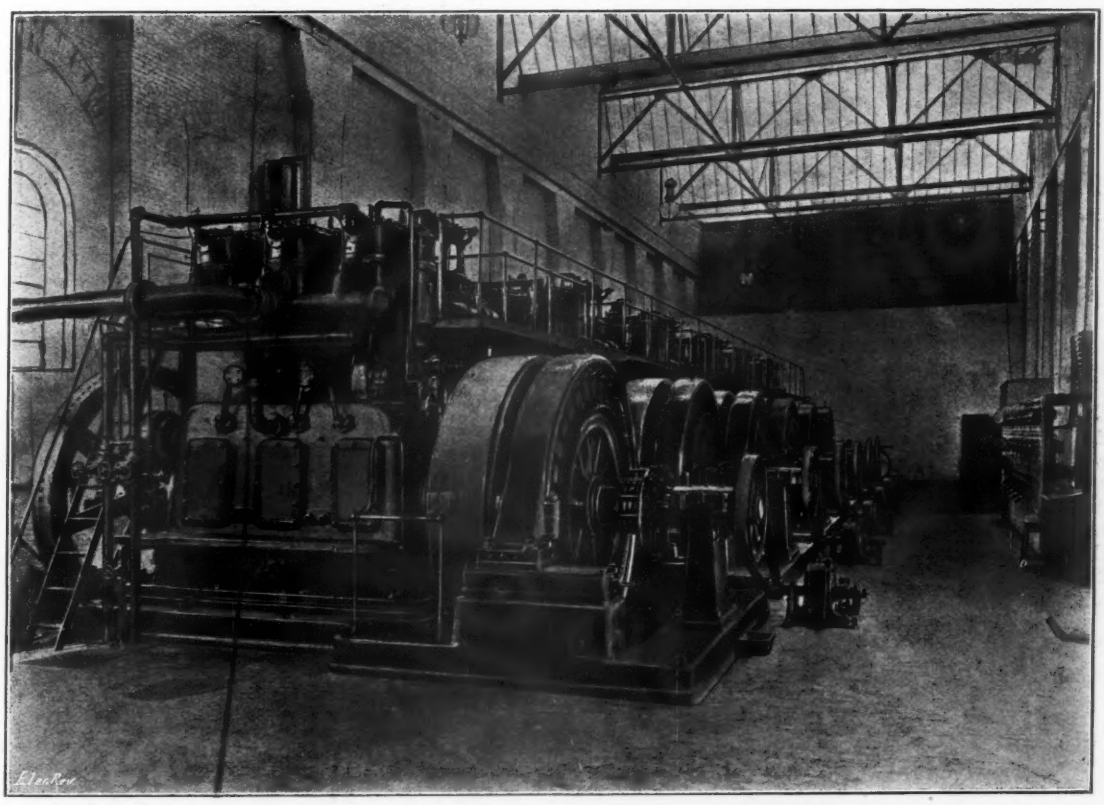
The positive electrodes are composed of magnetic iron oxide, titanium oxide, and chromium oxide, the negative electrodes being generally made of copper. At Poughkeepsie the average life of negative electrodes has been found to be about 200 hours, while the positive electrodes have not been replaced since first installed.

A good white light is given, and the distance at which print can be read is about 25 per cent. greater than with the ordinary carbon arc lamp. Luminometer readings show that the intensity of illumination at 309 ft. given by the magnetite lamp taking 310 watts is the same as that given at 275 ft. by the direct-current enclosed series arc lamp taking 480 watts, and at 247 ft. by the alternating-current enclosed series arc lamp taking 480 watts.

General experience shows that the system is about 50 per cent. cheaper to run than the old open-arc method of street lighting, and about 20 per cent. cheaper than the series alternating system.

Low-voltage mercury arc rectifiers are much used and very well adapted for the purpose of charging cells, and are exceedingly convenient for use with electric automobiles on account of the little attention necessary, and the extreme ease and economy with which they may be run.

The comparatively small cost of installation, economy in energy consumption, cheapness of operation and high efficiency, together with the fact that resistance losses are almost negligible, and that such an extraordinarily small amount of copper is required in the transmission lines and fittings, should warrant a trial in one or other of those districts in England in which high-pressure transmission is being used, when engineers will be able to see and judge for themselves the value of all the advantages of the system herein described.



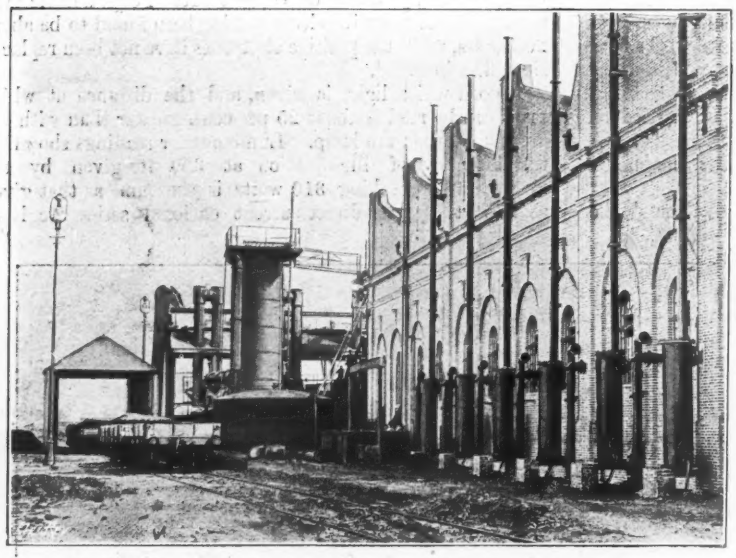
Westinghouse Gas-Electric Generating Plant, Banfield Power House, B.A., Gt. Southern Railway (see p. 1058).

ELECTRICALLY-EQUIPPED RAILWAY SHOPS IN THE ARGENTINE.

(*Concluded from page* 1019.)

The Banfield Plant of the B.A. Great Southern Railway.

These workshops—for the equipment of which also the British Westinghouse Co. were contractors—are situated on the main line of the Buenos Ayres and Great Southern Railway, 12 kilometres from Buenos Ayres.



View of the Mond Gas Plant, Banfield Power Plant.

The workshops are distributed over a considerable area, and, for this reason, the engineers recommended a central power station from which electrical energy could be distributed to the various shops and stores departments, with light and power for the company's Dock Sud, and all the freight and passenger stations along the line for a distance of about 22 kilometres.

It was also decided to install Mond gas-producer plant, and Westinghouse vertical three-cylinder gas engines, direct coupled to Westinghouse three-phase 50-cycle generators.

The gas producer plant, which is designed to supply gas continuously to 2,000-I.H.P. of gas engines by gasifying bituminous slack, is one of the most complete and compact of its kind.

Coal is conveyed by rail to the plant, and elevated into a worm conveyor, which delivers it into 25-cwt. coal bunkers, one of which is situated over each producer, and forms a storage of about six hours capacity. From the bunker the coal passes through chutes to four producers, each resting on a water lute—from which the ashes are drawn as found necessary, without stopping the make of gas. Inside each producer is fixed a bell through which the coal passes, partly filling it and automatically keeping the level of the fuel in the producer at the same point.

The gas passes successively through superheaters (where it heats up the air and steam used in the producers), washers, and coolers, to a 20-ft. diameter gasholder, and thence to two 25-in. diameter fans. The fans, by their centrifugal force, throw out any particulars of tar and dust, &c., being aided by the injection of a stream of cold water into the interior of the fans. To ensure absolutely clean gas, it is finally passed through two 8-ft. square sawdust scrubbers, after which it is ready for use in the gas engines.

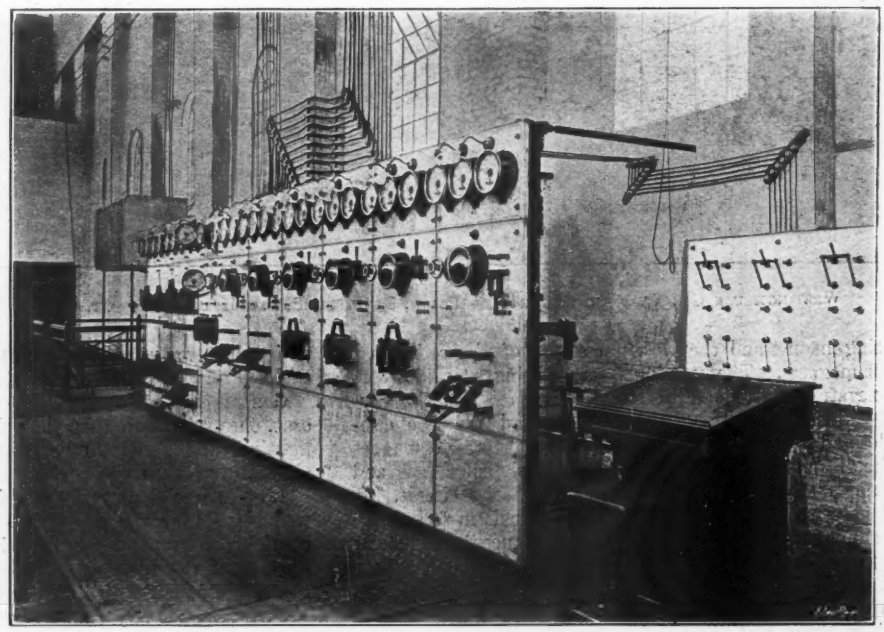
Worthington pumps are provided for circulating the water round the towers; tanks are provided for each tower, and are periodically skimmed of the tar and dust which collects on the surface of the water.

In the generating station itself are six Westinghouse vertical three-cylinder single-acting gas engines, each having a normal output of 250 H.P., directly connected to Westinghouse three-phase 50-cycle 440-volt alternators of 150 KW. each. The switchboard is of the well-known Westinghouse standard type.

From this plant power is distributed by overhead transmission lines to the various workshops and stores departments, offices, &c., at 440 volts for power and 110 volts for lighting. Westinghouse three-phase type "C" induction-motors are used throughout the works.

In the locomotive erecting, carriage, and wagon shops, groups of lathes, shaping tools, &c., are driven from countershafts, belted to motors ranging from 10 to 20 H.P. Individual drive is practised for driving sawmill machinery, air compressors, fans, pumps, &c. The shops work eight hours per day, and consume about 4,500 KW. during the daily run.

A large part of the energy generated in the power station is stepped up from 440 to 6,600 volts, and transmitted over the high-tension system by underground lead-covered, paper-insulated cables, laid in earthenware troughs and pitched in, the cables being laid in duplicate throughout the system. The main cables are run direct to Kilometre 5 sub-station, a point about half way between Plaza Constitution and the



The Switchboard, Banfield Power Plant.

power house. From this sub-station two branches are taken off, one to Plaza Constitution terminal station, and the other to Dock Sud, both of which are protected by high-tension fused switches. In this sub-station step-down transformers are also installed for the lighting of Kilometre 5 Clearing Yard. These work day and night and consume a considerable amount of energy. From this point, along the main line of the railway to Plaza Constitution, branches are taken off for the various freight and passenger stations along the line, each of which is protected by high-tension fused switches.

In the Dock Sud sub-station there are installed two 400-KW., 50-period Westinghouse rotary converters, which supply direct-current at 550 volts for cranes, capstans, grain elevators, &c., along the dock. One of the rotary converters is sufficient for the present demand, the other being held in reserve.

Two step-down transformers are installed for the lighting of the dock, grain elevators, stores, offices, &c.

The low-tension cables, both for light and power are lead-covered, paper-insulated, and laid on the same system as the high-tension cables, but carried in wooden troughs suspended from the wooden piles of the wharf.

There is now under construction an overhead high-tension line, from the power station to Burzaco, a distance of about 10 kilometres. This line will also supply light and power to the intermediate stations along the line.

The plant was put into service on March 14th, 1904, and during the first six months there were three stoppages, the whole amounting to nine minutes, the delays being principally caused by accumulation of water in the gas mains, but during a period of two years the different departments have suffered no delays through want of energy.

The number of men at present employed with five engines running is 23.

The engine-room staff is not more than would be required for a steam-driven plant; but, on the other hand, the gas plant necessitates nearly twice as many men as a steam plant of the same capacity, but it must be taken into consideration that a plant 50 per cent. larger could be operated by the same staff.

The average coal consumption during the past six months, including day and night working, plus all losses from the time it leaves the ship, amounts to 3·1 lb. per KW., but as low as 2·10 lb. per KW. is constantly reached with the day-load.

The following is the working cost per unit obtained for a period of six months:—

	Day.	*Night.*	*Average.*
Fuel	0·2574d.	0·4356d.	0·3762d.
Oil, waste, and stores	0·0495d.	0·0990d.	0·0643d.
Repairs	0·0594d.	—	0·0594d.
Wages	0·2376d.	0·4851d.	0·3465d.
Total	0·6309d.	1·0197d.	0·8464d.

LIGHTING and POWER NOTES.

(*Concluded from page* 1054.)

Cardiff.—The Finance Committee of the T.C. has sanctioned the expenditure of £4,507, for extensions of plant, &c., to meet demands for energy for the Great Western Railway Co., and other consumers in the Dock District.

Dover.—The L.G.B. has re-opened the question of the purchase of the electricity works by the T.C., on an application by the latter for a further loan. The board intimates that, on the information before it, it considers that the advice on which the Corporation acted was entirely mistaken; that an excessive price was paid; and it further asks for all documents in the case. The Corporation has pointed out that reasons for its present position are the increased financial payments due to restricted period loans, and the low price charged for the supply.

Glasgow.—At a meeting of the Electricity Committee of the Corporation, the engineer reported that, on account of the increasing demand for electrical energy in and around Pollokshaws and in the Dumbreck district, it would be necessary to put down a sub-station for these districts, and it was decided that he should report on the matter. At a subsequent meeting the Committee agreed on the erection of a new sub-station central to the above areas, with the necessary transforming plant, and the laying of two high-tension mains from St. Andrew's Cross generating station to the sub-station. The engineer also reported that it would be necessary to put down additional generating plant to meet the demand for electricity during the winter of 1908-9, and it was agreed to remit the matter to the Sub-Committee on Works for consideration and report.

Heanor.—The Derbyshire and Nottinghamshire Electric Power Co. has written the Local Tradesmen's Association pointing out that the cost of introducing electricity into the area would amount to £5,000. It was contended by local speakers that a more probable figure was £28,000, and a Committee was formed to visit neighbouring towns and investigate.

Kingswood.—With reference to the application of the Electrical Supply Co. for an extension of time for carrying out the E.L. order, the U.D.C. has decided to inform the B. of T. that it is in the interests of the district to have an electrical supply, that the Council has no idea of providing such a supply itself, and that it hopes an extension of time will be granted.

London.—WESTMINSTER.—At the meeting of the City Council last Thursday, the Highways Committee stated that it had had under consideration the question of the public lighting of Oxford Street. There were 35 double and 12 single arc lamps. The total original cost of these lamps was £3,387, or £72 1s. 3d. per lamp. The annual cost of maintenance was £1,675, or £20 13s. 5d. per lamp. The following tabulation shows the comparative costs of the St. Marylebone Borough Council lamps and the St. James' and Pall Mall Electric Light Co.'s lamps in Westminster:—

	Marylebone Borough Council.	St. James' and Pall Mall Electric.
Capital cost per standard	£72 1 3	£45 0 0
Or equals capital cost per lamp ...	41 6 1	—
Cost of illuminant per arc per annum	20 13 5	17 0 0
Average candle-power of single arc lamps	1,600	1,018
Cost per candle-power per annum ...	3s. 1d.	4s. 0d.

The candle-power of the double arc lamps was more, but the exact figure could not be ascertained. The readings from the double lamp observations were not satisfactory by reason of interference of the light rays from the two lamps.

STOKE NEWINGTON.—At the meeting of the B.C. on December 17th, the joint report of the Electric Lighting and Public Health Committees on electric lighting and the dust destructor was carried. It may be remembered that the report was submitted to the Council on November 19th, and the debate was then adjourned. The report recommended an expenditure of £3,700 on the extension of the works, and the utilisation of the steam from the dust destructor.

Oystermouth.—The District Council, at a special meeting, has considered the advisability of applying for a provisional order for lighting the district by electricity at an estimated cost of £15,000.

Southend-on-Sea.—The T.C. has decided to have an estimate prepared of the cost of extending the E.L. mains to a new estate being developed by Beadel, Wood & Co., 97, Gresham Street, London, E.C., on behalf of Colonel Burges, Thorpe Hall, Southchurch.

Warmley.—The Council is to apply to the B. of T. for an extension of time under the Warmley E.L. order, 1903, and for authority to transfer the latter to the Kingswood Electrical Supply Co.

Wolverhampton.—The Midland Electric Power Corporation has decided to extend its mains to the Fallings Park Estate, Heath Town, where there are many workmen's houses waiting to be connected. Energy will be supplied at 3½d. per unit.

Wrexham.—A L.G.B. inquiry was held on December 19th into the application of the T.C. for a loan of £575 for the provision of a 60-KW. generating set. There was no opposition.

TRAMWAY and RAILWAY NOTES.

Belfast.—The tramway manager has submitted a report of the traffic superintendent urging that reduced services (from 5 minutes' to 10 minutes' interval) on five outlying sections would be detrimental to the department.

Halifax.—The report of Lieut.-Col. Druitt on the runaway accident on the Sowerby Bridge route on October 15th contains some instructive reading. From this it appears that the ill-fated car was fitted with ordinary control gear at one end and with a special control, combined with a run-back appliance at the driving end when hill climbing, the car being employed on a shuttle service. Unfortunately, the driver did not realise the presence of the run-back brake, and even had he done so, it appears somewhat doubtful whether, owing to the presence of a loose connection in the controller, the electrical braking power would have been sufficient. The Inspector recommends the Corporation to equip its cars working on steep gradients with a form of slipper brake, which can be applied instantaneously, and adds various suggestions as to the working on the section in question.

Huddersfield.—The depôt at Great Northern Street is to be extended so that all the cars can be stored there; the open shed at the power station at Longroyd Bridge, now used for the storage of cars, is to be utilised as a coal store.

The track is to be doubled in Westgate, Trinity Street, Lockwood Road, and St. John's Road, at an estimated cost of £12,000, for which the profit on the past year's working will be taken, the balance being obtained from the renewals fund, which stands at £54,000.

The price of energy to be used by the West Yorkshire Tramways Co. for the cars running within the borough has been fixed at 1½d. per unit plus the cost of laying cables to Fartown Bar.

Kimberley.—The P.C. has passed a resolution consenting to the application of the Notts. and Derbyshire Tramways Co. for an extension of two years for carrying out the tramway scheme.

Kingswood.—The U.D.C. has decided to oppose the application of the tramways company for an extension of two years for the construction of the tramways in the district, in order to secure a *locus standi*.

Leeds.—Considerable discussion has been aroused in Corporation circles by the criticisms of the technical Press on Leeds tramway finance and other local matters. The chairman of the Tramways Committee has pointed out that the Finance Committee are responsible for the wholesale depletion of the tramway funds for rate-aiding purposes, and that other proposals regarding the combination of the Tramways and Electricity Committees are due to the Council.

Liverpool.—Mr. C. W. Mallins, the manager of the Corporation Tramways, some time ago invented a new sanding apparatus, and 300 of the city's cars have now been equipped with it, with good results. Mr. Mallins has now added an arrangement for dealing with a car running backwards, and a practical demonstration of this contrivance will shortly be given.

London.—L.C.C.—In an action brought against the Council by a Stamford Hill doctor, the latter was awarded £440 damages and costs in respect of personal injuries and damages to a horse and brougham by one of the Council's cars. Two other actions of a similar character resulted in the Council being mulcted in £80 and costs, and £100 and costs respectively.

Middlesex.—At the meeting of the County Council on December 19th, it was reported that a further section of the tramway line from Willesden Green to Dudden Hill Lane would be opened shortly. It is anticipated that the whole of the line from Edgware to Craven Park will be ready for public traffic in about one month. In connection with the construction of the line from Acton to Harlesden, the Great Western Railway's bridge at Acton station is to be widened and strengthened. The work, which is estimated to cost £4,050, is to be carried out by the railway company at the expense of the County Council. Subject to the Metropolitan Electric Tramways, Ltd., agreeing to the cost being treated as part of the capital of the County Council on which the company have to pay interest, a contribution of £2,000 is to be given to Friern Barnet U.D.C. towards the cost of widening the Great Northern Railway bridge carrying the Friern Barnet Road over the railway. Complaint is made as to the slow progress in connection with the construction of the London and North-Western Railway Co.'s bridge at Willesden Junction. Messrs. Blackwell & Co. have the contract for the tramway, and the construction is being delayed owing to their not having yet given an order for the steel-work required for the bridge.

Milngavie.—A plebiscite of the ratepayers has favoured the extension of the Glasgow Corporation Tramways to the burgh.

Perth.—The T.C. has deleted the tramway extension to Dovecotland from its provisional order, and the citizens in the quarter of the town affected are up in arms. It is pointed out that the extension would put the tramways on a better financial footing.

TELEGRAPH and TELEPHONE NOTES.

Brazil.—In a recent report on the trade of Brazil the Austro-Hungarian Consul at Rio de Janeiro states that the telegraph system of Brazil has rapidly developed during recent years, and there are at present 60,000 km. of land, sea, and river lines and ables. The Government telegraph lines have a length of 27,349 km. with a total length of wire of more than 50,000 km., and 3,331 elegraph stations. Special attention during the year 1906 was paid o the extension of the landline 2,100 km. long from Rio de Janeiro o Cuyaba (Matto Grosso) to the Acro district and San Antonio on he Maderia River and from there to the capital of the State of Amazonas. This town (Manaos) is at present only united to the Brazilian system by the line of the English Amazonas Telegraph Co. and the river cable in the Amazona River to Belem de Para. By the above-mentioned extension a new, shorter and more convenient direct line would be established between the North and the Federal Capital of Brazil. The Acro district has at present no telegraphic communication, which is also true of San Antonio, for which town such a communication will become necessary as a result of the construction of the Madeira-Marmore Railway. The Brazilian Telegraph authorities have now decided to construct the Cuyaba-San Antonio line with a branch to the districts of the Alto Acre, Alto Purus and Alto Juruss, and a commission, under the leadership of Major Rondon, has been sent out to lay this line as well as to make investigations with a view to the construction of a railway in the above-mentioned districts. As the line of the Brazilian Government has already touched the border of Paraguay in three places, endeavours are being made to establish direct communication between that country and Brazil. Of the foreign telegraph companies established in Brazil, may be mentioned the English company "Amazonas Telegraph Co.," which constructed a line between Manaos and Belem de Para, and received from the Government a yearly subvention of £17,125 for 10 years from 1895; and the Western Telegraph Co., also an English company, which laid submarine cables along the Brazilian coast and to Europe. Telephone systems exist in Rio de Janeiro, and in the larger towns of Brazil. They are the property of private companies, the one in Rio de Janeiro belonging to the light and power company. There is no doubt that in time, with the extension of business which is at present being witnessed, these systems will rapidly increase and extend.

China.—The Chinese Administration announced that the route *vid* Helampo was again opened for traffic on the 14th inst.

Cuba.—The Cuban Government has opened new telegraph offices at La Sierra in Orienite, Agramonte and Jaguey Grande, in Motanzas; also at Ranchuelo in Santa Clara, and at Camp Florido and El Rericon, in Havana Province.

Jamaica.—At the end of their financial year the Jamaica telegraph and telephone systems were represented by 64 telegraph stations and 7 telephone stations. During the year all the telegraph stations had been overhauled. The revenue from telegraphs amounted to £6,614, and this represents a considerable increase on the estimates. £8,012 was spent in repairs to buildings and telegraph lines rendered necessary by the earthquake.

Pacific Cable.—Agitation on the part of the Press in Australia has given rise to representations to the Pacific Cable Board to reduce Press rates between Australasia and Great Britain. The *Standard* published a Reuter telegram, which stated that Sir Joseph Ward, the Premier of New Zealand, in the course of an interview said that he was in communication with the Pacific Cable Board, and that it was sought to reduce the rate from 1s. to 4d. per word. Mr. Reeves, the High Commissioner in London, had suggested the use of wireless telegraphy in this connection. New Zealand, he stated, was willing to co-operate with the Commonwealth for this purpose.

Telegraphic Interruptions and Repairs:—

CABLES.	INTERRUPTED.	REPAIRED.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo } Closed..	Jan. 12, 1906 ..	..
Lagos-Kotonon	Dec. 4, 1907 ..	..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904 ..	..
Garachico-Santa Cruz	July 12, 1906 ..	Dec. 17
Brest-Dakar	July 22, 1907 ..	..
Cueta-Tangier	Dec. 7, 1907 ..	..
Falmouth-Bilbao	Dec. 9, 1907 ..	Dec. 18
LANDLINES.		
Puerto-Barrios	Aug. 2, 1902 ..	..

Wireless Telegraphy.—The Amalgamated Radio-Telegraph Co. states that wireless telegrams between Newcastle and Copenhagen, and Berlin and Copenhagen, can be received on an inking recorder.

Wireless Telephony.—It is announced that, by means of the Poulsen system, wireless telephony was established last week between the Weissensee station at Berlin and the Lyngby station near Copenhagen.

CONTRACTORS' COLUMN.

OPENINGS FOR NEW BUSINESS.

AINSDALE.—Parochial hall. Trustees of St. John's Church, Ainsdale.

ASHTON-UNDER-LYNE.—Proposed E.L. plant at the workhouse for the B.G. (£2,250).

AYLESBURY.—Residence in Manor Park for Mr. Darvill.
Stables, &c., at Halton for Alfred de Rothschild.

BARNSLEY.—New schools at Ardsley (£5,300). A. B. Linford, architect, Wombwell.

BERWICK-UPON-TWEED.—Residence at Tweedmouth for Robert Calder. C. S. Errington, architect, Victoria Buildings, Grainger Street West, Newcastle-on-Tyne.

BIRKDALE.—Two houses in Liverpool Road for Mr. A. Inglis.

BIRKENHEAD.—New factory for A. H. Lee & Sons, Warrington.

BIRMINGHAM.—New workshops and children's shelter in connection with the Birmingham Institution for the Blind.
(WASHWOOD HEATH).—New Council School in Leigh Road. J. A. Palmer, secretary, Education Department, Edmund Street, Birmingham.

BRENTFORD.—Enlargement of Ealing Road school (160 more places). H. G. Crothall, architect to Middlesex Education Committee, Guildhall, Westminster, S.W.

BRISTOL.—New police station at Eastville (in building). City Engineer.

BURY.—New Salvation Army hall at Moorgate.

CARISBROOKE (Isle of Wight).—New place of worship and schools at Bowcombe. S. E. Tomkins, architect, Castlehold Chambers, Newport, I.W.

CARSHALTON.—Fifteen shops in Ruskin Road for L. Alwyn.

Four semi-detached and one detached residences in Dalmeny Road for G. Hole.

CHADDERTON (Oldham).—New cotton mill. Mars Spinning Co. (new concern).

CHELTENHAM.—Proposed new Medical Baths near Queen's Hotel (£10,000).

CHURWELL (Yorks).—Proposed new cotton mill.

COVENTRY.—Shops in Queen Victoria Road for Gravenor & Farmer.

Twenty houses in Broomfield Road for C. J. Smith.

Sixteen houses in Earlsdon Lane. C. Luck & Son, builders, Coventry.

CROYDON.—Proposed new secondary schools at Selhurst.

Extensions to the Mental Hospital at Warlingham for the T.C. (£90,900).

DERBY.—Alteration of shop and premises for cycle and motor works. R. Weston & Son, builders, Derby.

DEWSBURY.—Extensions at G. H. Hirst & Co.'s dye works.

DIRLETON (N.B.).—New villa residence. Taylor Bros., Cedar Grove Nurseries, Dirleton, near North Berwick.

DUNDEE.—Building in Constitution Steeet for Salvation Army.

Alterations to property in Cowgate for Esplin & Clark.

Alterations to premises in Ward Road for Ancient Order of Foresters.

New wing at King's Cross Hospital to cost £4,000 (proposed). Mr. Thomson, burgh engineer.

ENFIELD.—Enlargement of grammar school (230 more places). H. G. Crothall, architect to Middlesex Education Committee, Guildhall, Westminster, S.W.

CADISHEAD (Lancs.).—New schools for the C.C. (£4,747). T. Moore & Sons, builders, 24, Monton Road, Eccles, Manchester.

FISHGUARD.—New Council schools. D. E. Thomas, architect to the Pembrokeshire Education Authority, 17, Victoria Place, Haverford West.

FLEETWOOD.—65 houses and shops for E. Crosby.

GERRARD'S CROSS (Bucks).—Block of business premises in Oak End Waye, for P. A. Hopkins.

GLASGOW.—Block of business premises in Dumbarton Road, Scotstoun. A. Fountain, 68, Gordon Street, Glasgow.

HALIFAX.—Residence at Rishworth. Walsh & Nicholas, architects, Museum Chambers, Halifax.

HARROGATE.—Additions to White Hart Hotel. W. A. Bartram, architect, Harrogate.

HASTINGS.—New fire station at St. Leonards for the T.C. P. H. Palmer, borough engineer.

HECKMONDWIKE.—Alterations to the Albion Hotel.

HIGH WYCOMBE.—New Board Room for the Board of Guardians. Hooper and Nash, architects, High Wycombe.

Motor Garage, Hunt & Son, builders, High Wycombe.

New public schools (£6,850). T. Thurlow, architect, 95, High Street, High Wycombe; R. Cleaver, builder, Northampton.

HULL.—Shops and offices in Victoria Square for the North-Eastern Railway Co. Wm. Bell, architect to the company, York.

Alterations to the Grand Theatre for Mortons, Ltd.

HYDE.—Houses (12) in Vale Street for R. Wheeler & Co.

ILFORD.—School at Goodmayes (1,210 places). C. J. Dawson, architect, 7, Bank Buildings, High Street, Ilford.

INVERURIE (N.B.).—Proposed extension to municipal buildings.

KELSO (Smailholm).—Hospital buildings at Boghouse for the Border Combination Smallpox Hospital Committee. G. Monteath, architect, Newtown St. Boswell's, Roxburghshire.

LEICESTER.—Proposed new mission institute in West Humberstone.

LEIGH (Lancs.).—New mill for the Hall Lane Spinning Co.

LEVEN (Fife).—New Bain Hospital, to cost £1,700. A. C. Dewar, architect, Leven.

LINCOLN.—Additions to the Duke of Wellington hotel, including new billiard room, for Mowbray & Co., Ltd.

LONDON (Harlesden).—Alterations to shops, High Street. S. W. Cranfield, 14, Gray's Inn Square, W.C., architect.

(Cricklewood).—Nine houses. S. & E. Banks, 163, Cricklewood Broadway, agents.

(Harlesden).—Two shops for Beeson Bros., 44, High Street, Harlesden.

(Willesden, N.W.).—21 houses. J. C. Hill, 55, Glenmore Road, Hampstead, builder.

Alterations and additions to 217, Willesden Lane. G. A. Sexton, architect, 42, High Road, Kilburn.

(Harlesden).—Thirteen houses. Done, Hunter & Co., High Road, Cricklewood, N.W., agents.

(Willesden Green).—Alterations to "The Crown" public house, High Road, for the Royal Brewery. Brentford, Ltd., 171, Queen Victoria Street, E.C.

(Cricklewood).—Six houses. G. H. Pargeter, 95-97, Finsbury Pavement, E.C., architect.

(Victoria, S.W.).—Rebuilding S.W. District Post Office on enlarged site. H.M. Office of Works, Storey's Gate, S.W.

(Woolwich).—Coal store at Brook Hospital. W. T. Hatch, engineer-in-chief, Metropolitan Asylums Board, Embankment, E.C.

(Brixton).—Extension of school building (£25,000). T. J. Bailey, architect, Education Committee, L.C.C., Spring Gardens, S.W.; E. Lawrance & Son, Wharf Road, City Road, builders.

(Pall Mall).—Premises for Royal Automobile Club on site of old War Office buildings. Secretary, Royal Automobile Club, 119, Piccadilly, W.

(Islington).—Additions to Workhouse (£15,000). E. Davey, Clerk, Guardians' Offices, St. John's Road, Upper Holloway, N.

(Finchley Road).—Buildings for R. Hovenden & Sons, Ltd. With reference to this notice published in our issue of December 13th, Messrs. Hovenden ask us to state that their sole connection with those premises was as shopfitters and plumbers for the tenant.

(Balham).—22 houses. F. Eaton, 12, Earlsfield Road, Wandsworth, builder.

(Kensington).—Buildings in Basil Street. Holland & Hannen, 12, Hyde Street, W.C., builders.

(Stonebridge, N.W.).—Mission hall in Melville Road. Rev. Canon Humphrey.

(Clapham).—Secondary school (£26,000). T. J. Bailey, architect, Education Committee, L.C.C., Spring Gardens, S.W.; Holliday and Greenwood, Ltd., Lockborough Park Works, Brixton, S.W., builders.

MAIDENHEAD (Taplow).—Houses in Ellington Road for Mrs. Summers.

MALMESBURY.—Residence for Mr. Farmer.

MANSFIELD.—Additions to Forest House for the Duke of Portland.

MARKET DRAYTON.—New secondary school for Salop C.C.

MITCHAM (Surrey).—Houses (56) in Asbourne Road for J. Wilson, Gorringe Park, Mitcham.

MORECAMBE.—Proposed new art school. County architect.

NEWQUAY.—Important alterations and additions to the Great Western Hotel. Cowell & Cowell, architects, Newquay.

PARTICK.—Proposed new public baths and washhouses.

PENRITH.—Residence at Patterdale. Empsall & Clarkson, architects, 7, Exchange, Bradford, Yorks.

RADCLIFFE (Lancs.).—New vicarage. J. Sellers, Son & Orrell, architects, Union Chambers, Bury.

RAVENSTHORPE (Yorkshire).—New sheds. New Town Mills, Ravensthorpe.

ROCHDALE (Castleton).—New mill for the Clyde Mill, Ltd., a new concern.

ROTHERHAM (Mexborough).—New fire station (£425). G. H. Smith, builder.

New Council Schools at Thrybergh (£3,708). Nicholson & Sons, builders, Leeds.

RUSHDEN.—Additions to factory for H. W. Chapman. Talbot Brown and Fisher, architects, Wellingborough.

MORLEY (Yorkshire).—Extensions at Prospect Mills and City Mills.

ST. HELENS (Lancs.).—St. Mark's Children's Hall and Church (£4,000). F. S. Biram, architect, Hardshaw Street, St. Helens. R. Ellison, builder, Windle Street, St. Helens.

ST. HELENS (Isle of Wight).—New vicarage.

ST. IVES.—Proposed new fire station. E. Boase, town clerk.

SHAW (near Oldham).—Extensions to Shaw British School (£1,700). J. W. Riley, clerk to the Shaw and Royton Education Committee.

SLOUGH.—Houses in Arthur Road for Burfoot & Butler.

SOUTHAMPTON.—Extensions to the Grammar School, for the Governors.

SOUTHEND-ON-SEA.—Bungalow residences in South Avenue for W. Goldsworthy, builder.

STEVENAGE (Herts).—Residence at Knebworth for Mr. Rouzier. Mr. Tregelles, architect.

STOCKPORT.—New Church, St. Michael and All Angels, at Bramhall (£7,500). Rev. H. Sewell, Rector.

SUTTON-ON-SEA (Lincs.)—Bungalow residence, for Poyser & Savage, Nottingham.

SWANSEA.—Proposed new lunatic asylum. G. T. Hine, consulting architect, 35, Parliament Street, Westminster, S.W.

SWINTON (near Manchester).—New spinning mill for a new company (not yet registered).

TREWELLARD (Cornwall).—New Wesleyan Sunday Schools. R. H. Roberts, architect, St. Just.

UXBRIDGE.—Additions and alterations at The Elms, Iver, for Messrs. Chadwell.

WEMBLEY.—School in Blind Lane (600 places).—H. G. Crothall, architect to Middlesex Education Committee, Guildhall, Westminster, S.W.

WIGAN.—New Roman Catholic Church, St. William's, at Higher Ince.

WOLVERHAMPTON.—Extension of business premises for Chas. Clark & Son, Chapel Street.

Extensions to premises at St. Peter's Works, St. Mark Street, including workshops and motor garage, for Barnett & Lewis.

YARMOUTH.—Proposed Presbyterian Church in Trafalgar Road.

CONTRACTS OPEN and CLOSED.

OPEN.

Algiers.—January 10th. The Post and Telegraph Inspector-General requires tenders for 1, 3 and 5 mm. iron wire.

Australia.—Adelaide, South Australia.—March 11th. The Postmaster-General requires tenders for the supply of one common-battery switchboard, 400 subscribers' telephones and 400 protectors.

Melbourne, Victoria.—January 21st. The Postmaster-General requires tenders for 250 visual vibrating indicators.

Austria.—January 2nd. The K.K. Postockonomie-Verwaltung requires tenders for materials for constructing telegraph lines. Particulars may be obtained from the Director, Postgasse 17 Wien I.

Austria.—The municipal authorities are about to invite tenders for the establishment of a central electric lighting station in the town of Nikolsdorf, near Linz.

Belfast.—December 28th. A double line of electric tramway, permanent way, electric masts, cables, wiring, lamps, &c for the Belfast Harbour Commissioners. See "Official Notices" November 22nd.

Belgium.—February 1st. The municipal authorities of Ghent are inviting tenders for the supply of 30 electric cranes, and the erection of the same along the new dock. Particulars may be obtained from, and tenders are to be sent to, L'Hotel de Ville, Ghent.

Belgium.—Tenders have just been invited by the municipal authorities of Engis (Liége) for the establishment of a central generating station in the town for the supply of electrical energy for public and private electric lighting and power purposes

Brussels.—December 31st. The Commandant du Génie requires tenders for the electric lighting of the Military School. Specifications, 1s. 8d., from 40, Rue de Reutiers. A deposit of £240 is required.

Finchley.—January 20th. One 350-kw. high-speed engine and dynamo, &c., for the Council's electricity works. See "Official Notices" December 20th.

France.—January 15th. The municipal authorities of Lyons are inviting projects for the establishment of a combination refuse destructor and electric power generating station.

Germany.—The municipal authorities of Lassan (Pomerania) are about to invite tenders for the establishment of a central electric lighting station in the town.

Ghent.—February 3rd. Tenders are required for the supply and erection of 30 electrical cranes for the quays of the new dock. Tenders must be submitted by February 1st. Particulars may be obtained from the Musée Commercial, 15, Rue des Augustins, Brussels.

Ilford.—December 30th. The U.D.C. requires tenders for the right to advertise on their tramcars. Conditions may be obtained from Mr. J. W. Benton, Clerk to the Council.

Kilkenny.—January 18th. Suction gas plants, gas engines, electric generators, battery, switchboard, mains, wiring, &c., for the District Lunatic Asylum. See "Official Notices" December 20th.

Leytonstone.—December 31st. The Leyton U.D.C. invite tenders for public lighting lanterns for incandescent lights. Specifications may be obtained, for £1 1s., from the Electrical Engineer, Electric Light and Power Works, Cathall Road.

London.—January 8th. The Metropolitan Asylums Board invite tenders for an electric lighting installation in the motor workshops and yard at a Fulham ambulance station. See "Official Notices" December 20th.

Manila.—January 15th, 1908. Sewage pumps to be worked by electric motors are required by the municipal authorities.

Rawtenstall.—December 30th. Three steam dynamos and accessories for the Corporation. See "Official Notices" December 20th.

Spain.—January 11th and 12th. The municipal authorities of Madrid require tenders for the construction, &c., of electric tramways in Madrid, from the Placa de los Ministerios, through the following streets, Encarnacion, Arrieta, Arenal, Puerta del Sol, Alcalá, Paseo del Prado, Juan de Mena, Alarcon, Felipe IV, Moreto, Espalter, to Alfonso XII. Particulars may be obtained from the Ayuntamiento Constitutional. Tenders by January 11th.

The Public Works Department of Madrid require tenders, &c., for the construction of electric tramways in Valencia, by January 12th.

Spain.—Tenders have just been invited by the municipal authorities of Villalba (province of Lugo) for the concession for the electric lighting of the town during a period of 20 years.

Spain.—The municipal authorities of Monforte (province of Lugo) have just invited tenders for the concession for the electric lighting of the town during a period of 30 years.

Tyrol.—The municipal authorities of Partschins (Tyrol), are about to invite tenders for the establishment of a central generating station in the town for the supply of electrical energy for lighting and power purposes.

CLOSED.

Faversham.—The T.C. has accepted the tender of Messrs. Drake & Gorham for the supply of 50 Hoadley attachments for Nernst lamps, at 2s. 3d. each.

Huddersfield.—In connection with the extensions at the electricity works, the following tenders have been accepted:—

Willans & Robinson.—Two 2,500-kw. turbines.
W. T. Glover & Co.—Cables.
Mirrlees Watson Co.—Condensing plant.

Ilfracombe.—The U.D.C. has received the following tenders for a combined refuse destructor and steam raising plant:—

Manlove, Alliott & Co.	£1,549
Horsfall Destructor Co.	2,131
J. E. Johnson & Son	2,203
Meldrum Bros.	2,227
Goddard, Massey & Co.	1,735
Stirling Refuse Destructor Co.	1,801
Heenan & Froud	2,478

London.—Stoke Newington.—The B.C. has accepted the tender of Mr. J. H. Golding, Garnham Street, Dalston, for electric light wiring in private premises for a year.

Southend-on-Sea.—The T.C. has accepted the following tenders:—

British Thomson-Houston Co.—B.T.-H.-Belliss steam dynamo, £3,034.
Callender's Cable & Construction Co.—Copper cables for one year, £68 per ton.

LORD KELVIN.

The Funeral.

The funeral took place in Westminster Abbey on Monday morning, the 23rd inst. The hour of noon was fixed for the ceremony, but ticket-holders were requested to be in their places by 11.30. Most of them complied with that request, and a solemn silence pervaded the edifice, to be broken shortly after by the strains of the music composed by Purcell for the funeral of Queen Mary, in 1694 — an old-world musical example of subdued sadness concluded by a thunderous sound that might well typify the Day of Judgment in more modern programme music. Then the Funeral March of Chopin, and silence reigned again, but only for a brief space.

A sound, not of pipes but of human voices this time, fell faintly on the ear, and singularly solemn was the effect of distance, for we knew that the hymn "Brief life is here our portion" was being sung by the choir at the head of the procession accompanying the body from the Chapel of St. Faith, through the cloisters to the Abbey. Very gradually the voices became more and more distinct. No sound of footfalls. Yet the measure of the music permitted us to realise the slow and solemn progress of the procession. The hymn ceased, and gave place, as the Cathedral was reached, to the opening sentences of the Burial Service, chanted by the singers as the procession moved up the nave to the choir. The appropriate lessons were read, an anthem was sung, the procession reformed and the bearers laid their burden upon a slightly raised dais. Another period of most solemn silence ensued as the bearers arranged the webbing by means of which the body should be committed to the ground. The service proceeded. We heard "earth to earth, ashes to ashes, dust to dust," and we knew that this was the final resting place of the mortal remains of the great scientist, a nobleman of noble mind.

To be interred in this sanctuary containing the ashes of the departed great was a fitting recognition of a career so full of honours, so full of years. We knew we were present at the obsequies of one who had accomplished much. Pomp and circumstance were there, but so appropriately attuned as never to intrude, so that we believe it safe to say that, as the service reached its end, the vast congregation thought less of the scientist's great works than of the man's kindly nature, less of the illustrious dead than of the life well lived. We knew that not a nation only, but the whole world of science had suffered the eclipse of a shining light, but for the moment we thought rather of the sorrows of those who had lost a beloved relative or a kindly friend.

The names of those who attended as representatives of the King and the Royal Family, the Royal and other learned societies, the Universities and Cities, are too numerous to permit us to record them. We must content ourselves with stating that the Institution of Electrical Engineers, of which Lord Kelvin was President at the time of his death, was represented by Sir William Preece, Dr. Glazebrook (one of the pall-bearers), Dr. Thompson (who also represented the Italian Institution), Sir John Gavey, Sir Henry Mance, Mr. R. Kaye Gray, Mr. Siemens, Colonel Crompton (in the uniform of the Electrical Engineer Volunteers, who provided a guard of honour for their dead Colonel-in-chief), the vice-presidents—Mr. Sparks, Mr. Gill and Prof. Kapp; the hon. treasurer, Mr. Hammond; and members of Council, Mr. Mordey and Mr. Patchell. Other members we observed were Mr. Duddell, Mr. Judd, Mr. Kingsbury, Mr. Swinton and the secretary, Mr. Lloyd. The American Institution of Electrical Engineers was represented by Mr. Parshall.

NOTES.

The Season's Greeting.—We heartily wish a happy and prosperous New Year to all our readers; and we trust that 1908 will prove memorable for the return of activity and prosperity to the electrical trades in this country.

Appointments Vacant.—Junior assistant engineers for the Newcastle-upon-Tyne Electric Supply Co., Ltd. (10s.).

Cricket Dinner.—The third annual dinner of the Marconi Cricket Club was held on Saturday, December 14th, at the City Arms Tavern, St. Mary Axe, E.C., Mr. H. Cuthbert Hall presiding over a company which included over 50 of the staff of the Marconi companies. The musical programme that followed was contributed to solely by the staff of the Marconi companies. The chairman congratulated the members on the successful 1907 season, when, out of 16 matches played, 9 were won, 4 lost and 3 drawn.

Petrol-Electric Motor-Car.—A Krieger 12-14-H.P. four-cylinder petrol-electric car, entered by M. F. Combemale, was last week submitted to a six days' trial under the official observation of the Royal Automobile Club, as a test of its general reliability. A start was made on the morning of the 16th inst., and the journey was for 100 miles in the country, 50 miles out and back, on the Oxford road. Tuesday's journey was for a similar distance on the Coventry road. Five days were devoted to the running of the car in the country, and one day was told off for a test in London traffic. The official report of the trial will appear later.

Institution and Lecture Notes.—Liverpool and District Electrical Association.—On Dec. 17th, Mr. J. J. Richardson delivered a lecture on "Electrical Appliances," at Liverpool. It was fully illustrated by lantern slides, and was of a both scientific and popular character. The lecturer dealt with the evolution of the incandescent electric glow lamp, the plants in large generating stations, and the lighting by means of arc lamps, and showed slides of artificial and electrical discharges produced by a large influence machine. Partiaular notice was drawn to the change in the design of generating stations due to the adoption of turbine-driven units, and slides were shown of different types of generators driven by these units. The next meeting of the Association will be held at the Common Hall on January 14th, 1908.

Civil and Mechanical Engineers' Society.—On January 2nd a discussion will take place on "Standard Notation for Engineering Formulæ," at Caxton Hall.

Institution of Electrical Engineers (Birmingham Local Section).—At the meeting to be held on Wednesday, January 15th, a paper will be read on "The Heat Conductivity of Iron Stampings," by T. M. Barlow, M.Sc., Student.

Institution of Electrical Engineers.—At the last meeting of the Institution, on December 19th, the ordinary business was suspended, owing to the death of the President, Lord Kelvin. It was unanimously agreed to forward a message of condolence to Lady Kelvin, and a telegram expressing the sympathy of the Associazione Elettrotecnica Italiana was read.

Foster Lamp Socials.—In order to mark the removal of the works and offices of the Foster Arc Lamp and Engineering Co., Ltd., to their new premises (owing to their greatly increased requirements), the staff have inaugurated a series of social evenings. The directors voted a sum to defray the cost of an excellent spread, and Mr. Milton Ely, one of the managing directors, gave the use of the Worple Hall, Wimbledon, and a comfortable supper room, for the function. An excellent programme was provided, and the company present numbered about 80.

Fatalities.—Wm. Smith, superintendent of the electric haulage plant at Fallin Colliery, near Stirling, died suddenly under peculiar circumstances at the pit head. It is assumed that he may have touched an electric cable and got a shock, but there were no marks about the body.

At the inquest on the body of Aaron Reed, who was killed in a collision with an electric car in Liverpool, the jury returned a verdict of "Accidental death," but considered that the driver of the car had committed a serious error of judgment. The driver had tried to pass a lorry driven by the deceased, at a point where the road was too narrow for the purpose.

New Bills.—New Outer London Tramway Schemes.—Printed copies of the West London, Barnes and Richmond Tramways Bill and of the Croydon and Southern Districts Tramways Bill have now been deposited in the Private Bill Office, the proposal in both cases being for the incorporation of new companies. In the case of the West London scheme, the proposed capital is £240,000, with the usual powers as to the issue of debenture stock, and the first directors named are Frederick Wm. Reynolds, A. H. Sanderson, Francis E. Savory, and Robert Percy Sellon. Thirteen tramways are set out in the Bill. No. 1 commences in the Lower Mortlake Road at or about its junction with Kew Road, passing along Lower Richmond Road, and terminating near Clifford Avenue. Other tramways will be in Richmond, Barnes, Hammersmith, Mortlake and Putney. The total length of tramway proposed is about 7 miles. Power is asked to run over the L.C.C. tramways in Hammersmith Broadway, and to make junctions with other tramways, and also to enter into agreements with the Richmond Electric Light Co. with regard to the supply of electric power. It is further proposed to modify the Tramways Act so that 60 years shall be substituted for 21 years as the period during which the local authorities shall not purchase. In the case of the Croydon and Southern District Tramways, the proposed capital is £85,000, and the first directors named are Joseph Bevan Braithwaite, Fredk. Wm. Reynolds, A. H. Sanderson, F. E. Savory, Robert Percy Sellon and Joseph Shaw. It is proposed to construct about 4 miles of tramway in Croydon, Beddington and Coulsdon, and to obtain power to run over certain tramways of the Croydon Corporation.

Lower Thames Dock Bill.—From the Bill for the promotion of a deep water dock at Grays, which is now printed, it appears that the proposed capital is £3,750,000. By Clause 47 the company take power to generate electric power for dock purposes. By Clause 69 it is proposed to take land in the parish of West Thurrock for the erection of a generating station, while Clause 154 enacts "the company on the one hand and any company, body or person on the other hand, may enter into and carry into effect arrangements and agreements with reference to the supply by such company, body or person to the company, or to any vessel or person at or within the dock, of a supply of electrical energy for all or any purposes of the company or of such vessel or person." Amongst the first directors is Mr. Robert Percy Sellon.

Home Office Colliery Prosecution.—At Bradford last week, W. H. Sharp, colliery manager, of Cleckheaton, was summoned at the instance of Mr. W. H. Pickering, H.M. Inspector of Mines, for using electrical apparatus and not having a competent person in charge; for using electrical motive power without giving the required notice; for failing to report an explosion of gas; failing to keep a plan showing the workings of the Westgate coal mine; failing to have electrical apparatus sufficiently guarded, and failing to record an escape of inflammable gas. It is stated that an explosion had taken place on October 27th, and the man who had control of the motors had not turned off the power at once. This resulted in another explosion the same morning, but, fortunately, the man was at the pit mouth at the time, and he escaped with a slight injury. The Home Office regarded the offence of not having the electrical plant sufficiently guarded as most serious, and defendant was fined £5 and costs. A similar penalty was imposed for using electrical apparatus without having a competent person in charge; for using electric motive power without giving notice he was further fined £3 and costs, and for the remaining offences was ordered to pay costs.—*Leeds Mercury.*

NEW COMPANIES REGISTERED.

Clyde Turbine Syndicate, Ltd. (6,702).—This company was registered in Edinburgh on December 17th, with a capital of £5,000 in £1 shares, to carry on the business of mechanical engineers, machinists, electricians, fitters, founders, saddlers, rubber manufacturers and merchants, dealers in turbine motors or engines, cycles, carts, wagons and carriages, &c. The first subscribers (each with one share) are:—R. A. Triscott, 77, Hereford Road, Bayswater, London, solicitor; C. R. Jamblin, 11, Lownds Avenue, Bromley, Kent, clerk; R. A. Wood, 18, Queen Victoria Street, E.C., M.D.; G. S. F. Griffin, Hampton Lodge, Acton Vale, W., secretary; M. E. Davies, The Dinn, Bromley Common, Kent, accountant; A. Spens, 21, Chepstowe Crescent, Notting Hill Gate, London, merchant; and H. Smallpage, 8, Clyde Street, South Kensington, London, clerk. The number of directors is not to be less than two or more than seven; the first are to be afterwards appointed; qualification, 50 shares; remuneration, £100 each per annum (chairman £150).

Harry W. Cox & Co., Ltd. (96,136).—This company was registered on December 19th, with a capital of £5,000 in £1 shares (4,000 7 per cent. cumulative preferred ordinary, and 1,000 deferred ordinary), to acquire the business of electricians, electrical and mechanical engineers, contractors, model makers, manufacturers of, and dealers in, electrical, medical and scientific fittings, implements, apparatus and appliances, &c., carried on by Harry W. Cox, Ltd., at 1A, Rosebery Avenue, E.C., to adopt an agreement with H. W. C. Cox, and to carry on the said business, and that of pneumatic and other bell suppliers and hangers, cable and wire manufacturers, &c. The first subscribers are:—H. E. A. C. Donnithorne, 76, Queen's Gate, London, engineer, 775 preferred ordinary shares; V. H. Donnithorne, 76, Queen's Gate, London, engineer, 775 preferred ordinary shares; H. G. Critchley, M.D., 55A, Welbeck Street, W., 700 preferred ordinary shares; E. T. M. Deanes, 22, Chancery Lane, W.C., solicitor, 400 preferred ordinary shares; J. L. Field, 91, Worple Road, Wimbledon, gentleman, 200 preferred ordinary shares; Mrs. E. F. Waite, 20, Southdean Gardens, Southfields, S.W., 100 preferred ordinary shares; and C. D. Waite, 20, Southdean Gardens, Southfields, S.W., 50 preferred ordinary shares. No initial public issue. The number of directors is not to be less than two or more than five; the first are H. W. C. Cox (managing director), Dr. H. G. Critchley, M.A., M.D., and H. E. A. C. Donnithorne. If the said H. E. A. C. Donnithorne resign office while holding 700 shares, he may nominate V. H. Donnithorne as his successor if the said V. H. Donnithorne be their technical manager; qualification 700 shares; remuneration one guinea each per board meeting attended. Registered office, 47, Gray's Inn Road, W.C.

Electric Locomotive Motor Propulsion Co., Ltd. (96,132).—This company was registered on December 19th, with a capital of £1,000 in £1 shares, to carry on the business of electrical engineers, accumulator manufacturers, makers of electrical plant and machinery, manufacturers of and agents for the sale, purchase and hire of motors, motor-cars, vans, wagons and launches, &c. The first subscribers are:—P. Schreiber, Electromotor Garage, Grosvenor Place, Bond Street, W., engineer, with 20 shares; C. Haunz, 15, Fieldhouse Road, Balham, S.W., engineer, with five shares; H. Foster, 67, Disraeli Road, Putney, S.W., gentleman, with one share; R. Kavanagh, Electromotor Garage, Grosvenor Place, Bond Street, W., engineer, with one share; J. Bruce, The Parade, Kew Gardens, accountant, with one share; E. Engelmann, 108, City Road, E.C., merchant; and W. Stevenson, 46, Gresham Street, E.C., merchant, with one share. No initial public issue. The number of directors is not to be less than two or more than six; the first are P. Schreiber (managing director), C. Haunz and H. Foster; qualification 20 shares; remuneration £50 each per annum (managing director £100). Secretary and registered office, J. Bruce, 25, Brewer Street, Regent Street, W.

Premier Accumulator Co., Ltd. (96,121).—This company was registered on December 18th, with a capital of £25,000 in 24,500 participating preference shares of £1 each and 10,000 ordinary shares of 1s. each, to acquire the business of electrical engineers carried on by A. Schanschieff and H. Stephens at Northampton, as the "Premier Accumulator Co.," to adopt an agreement with the said vendors and G. A. Schanschieff, and to carry on the business of electrical and mechanical engineers and contractors, suppliers of electricity, carriers of passengers and goods, manufacturers of and dealers in accumulators, railway, tramway, electric, magnetic, galvanic, telegraphic, telephonic and other apparatus, &c. The first subscribers (each with one preference share) are:—H. Stephens, 28, Hester Street, Northampton, engineer; A. Schanschieff, 138, Wellesley Road, Chiswick, W., engineer; G. A. Schanschieff, 6, Park View, Northampton, electrical engineer; H. W. Pender, 55, Overstone Road, Northampton, agent; W. J. Green, 26, Ruskin Road, Northampton, agent; T. Seabrook, 89, Kilmorie Road, Forest Hill, S.E., clerk; and A. T. Lee, 11, Gartmore Road, Seven Kings, Essex, secretary. No initial public issue; the number of directors is not to be less than two or more than five; the subscribers are to appoint the first; qualification, 500 preference or ordinary shares; remuneration as fixed by the company. Registered office Cattle Market Road, Northampton.

Torquay Tramways Co., Ltd. (96,012).—This company was registered on December 10th, with a capital of £120,000 in £1 shares, to adopt an agreement with the Dolter Electric Traction, Ltd., to construct, lay down, equip and maintain tramways and light or other railways in Great Britain, and in particular the tramways authorised by the Torquay Tramways Act, 1904, or any part thereof, to work such tramways or railways by electrical, horse, steam or other power, &c. The first subscribers (each with one share) are:—P. R. Reeves, 42, Crediton Road, Kensal Rise, N.W., clerk; W. J. Park, 43, Devonshire Street, Islington, N., clerk; S. Jordan, 115, Elm Park Mansions, Chelsea, S.W., gentleman; W. Escott, 29, Powell Road, Clapton, N.E., gentleman; A. W. N. Stuart, 4, College Street, Barnsbury, N., accountant; R. Bott, 36, Southcote, Woodside, S.E., gentleman; and W. J. McNelly, 15, Walter Street, Stepney, gentleman. No initial public issue. The number of directors is not to be less than three or more than seven; the first are J. T. Jervis, L. B. Schlesinger, and B. Bernheim. Registered office, Queen Anne's Chambers, Westminster, S.W.

Chipping Norton Electric Light and Power Co., Ltd. (96,082).—This company was registered on December 16th, with a capital of £2,000 in £1 shares, to carry on the business of suppliers of electricity for light, power or other purposes, electricians, electrical engineers, manufacturers of and dealers in electrical apparatus, &c., and to adopt an agreement with R. S. Bunting. The first subscribers (each with one share) are:—H. Bunting, 4, Horse Fair, Chipping Norton, plumber and decorator; Mrs. S. Bunting, 4, Horse Fair, Chipping Norton; W. E. C. Nichols, 15, Evington Road, Leicester, postal clerk; A. G. Lippitt, Meadow Croft, Knighton Road, Leicester, postal overseer; Mrs. F. Nichols, 15, Evington Road, Leicester; Mrs. S. Bunting, Meadow Croft, Knighton Road, Leicester; and Mrs. E. Lippitt, Meadow Croft, Knighton Road, Leicester. No initial public issue. The number of directors is not to be less than two or more than five: the first are R. S. Bunting and others to be appointed by the subscribers. Registered office, Bunford Road, Chipping Norton.

Bovey Light and Power Co., Ltd. (96,019).—This company was registered on December 11th, with a capital of £4,250 in 3,750 6 per cent. cumulative preference shares of £1 each, and 5,000 ordinary shares of 2s. each, to acquire lands, mines, mining rights and metalliferous lands in Devon or elsewhere, to crush, mine, quarry, smelt, refine, dress, prepare for market and deal in lignite, clay, ores, metals and minerals, to manufacture gas from lignite or otherwise, to produce and supply electric light and power, &c. The first subscribers (each with one preference share) are:—A. B. Phillpotts, 43, Bedford Row, W.C., solicitor; A. A. Surtees, 43, Bedford Row, W.C., solicitor; H. P. Surtees, 43, Bedford Row, W.C., solicitor; W. Hicks, 5, Oxford Gardens, W., solicitor; F. J. White, 481, Lea Bridge Road, Leyton, N.E., clerk; F. Birch, 123, Gower Street, W.C., solicitor; and E. A. Lewis, 33, Rossiter Road, Balham, S.W., clerk. No initial public issue; the number of directors is not to be less than two or more than six; the first are M. C. Olsson, W. Olsson and R. B. Phillpotts; qualification, £50; remuneration, £25 each per annum.

British Westinghouse Engineers' Club, Ltd. (96,057).—This company was registered on December 13th, with a capital of £500 in £1 shares, to adopt an agreement with N. Carlton and J. S. Peck, for the acquisition of certain premises at Trafford Park, Manchester, leased to the said parties, and to provide a club house and other conveniences for use of the members of the British Westinghouse Engineers' Club. The first subscribers (each with one share) are:—P. A. Lange, Hurst Dale, Altrincham, engineer; W. W. Blunt, Highfield, Altrincham, engineer; A. E. Scanes, 7, Addison Crescent, Kensington, secretary and treasurer of the British Westinghouse Electric and Manufacturing Co., Ltd.; Lieut.-Col. M. Cradocks, 90, Piccadilly, W.; N. Carlton, 2, Norfolk Street, Strand, W.C., engineer; F. B. Clarke, Honoresfield, Langham Road, Teddington, cashier; and F. A. Wilkin, 12, Toronto Road, Ilford, Essex, clerk. No initial public issue. The first directors shall be the following officials of the British Westinghouse Electric and Manufacturing Co., Ltd., viz.: P. A. Lange (general works manager), A. E. Scanes (secretary and treasurer), P. Einert (chief accountant); and J. S. Peck (consulting electrical engineer and chairman of the General Committee of the Club). No remuneration. C. Shears is the first secretary. Registered office, British Westinghouse Electric and Manufacturing Co.'s Works, Trafford Park, Manchester.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—At the York Corporation Electricity Works, on 20th inst., Mr. Hame, the city electrical engineer, on behalf of the staff, presented MR. W. A. TURNBULL, the works superintendent, with a case of silver tea knives, suitably inscribed, in view of his approaching marriage.

General.—MR. J. MUIRHEAD, B.Sc., A.M.I.C.E., who has been 4½ years on the designing staff of the British Thomson-Houston Co., Ltd., Rugby, has been appointed designer of D.C. plant with the Electric Construction Co., Ltd., Wolverhampton.

CITY NOTES.

The Adelaide Electric Supply Co., Ltd.

THE third annual general meeting of the shareholders of this company was held on Thursday of last week at the offices, Finsbury Pavement House, Mr. J. B. Braithwaite presiding.

The CHAIRMAN, in proposing the adoption of the report (see ELECTRICAL REVIEW, December 13th, page 983), said that the cost of the undertaking in Adelaide had risen from £188,922 to £211,188, which represented the additional capital expended in developing it during the year. Coming to the profit and loss account, the shareholders would be naturally disappointed at the financial results of the year, as were the directors. The revenue had increased from £16,580 to £19,952, an increase of £3,400, and there was a profit of £9,319. In Port Adelaide the result was a balance of £200 16s. 11d. against them, whereas last year they had £56 in their favour. The reasons for that disappointing result were not far to seek. They were due to the fact that during the past year they had been obliged to hold their hands with regard to increasing the business, owing to the delay experienced in getting their additional generating machinery. On that account during the greater part of the year they had been unable to push the connections of new customers as vigorously as they would otherwise have done. The same reason had prevented their closing down the station at Port Adelaide, which had always been a source of loss to them. As the shareholders were aware, their original intention when they formed the company was to operate it from Adelaide itself, but that, of course, they were not able to do until they had got their additional generating plant. Despite those drawbacks, he was glad to say that the actual growth of the business itself had been entirely satisfactory. He was pleased to say that the generating plant had now arrived, seven months behind time. It was started running in June, and on October 1st they were able to shut down the Port Adelaide station, and they were now supplying that place from Adelaide itself, so that for 10 months of the current financial year they would feel the benefit of that change, which he had no doubt would show itself in very considerably increased profits during the current year. The effect of having their new generating plant would enable them to begin to push the business in many new suburbs in Adelaide. During the year, 30 miles of street lighting was added, and the maximum load during the year made the greatest increase it had ever done in the history of the station, rising by just about 40 per cent., while the output showed an increase of 22½ per cent., which was almost exactly evenly divided between lighting and power. The earning capacity of the lamps was very much the same as last year, the private lighting lamp earning them just over 13s. per lamp per annum, and the horse-power on the mains earned them £4 16s. per I.H.P. per annum. During the recent visit of the Colonial Premiers, occasion was taken to meet them in a friendly way, and he was glad to say that Mr. Deakin, the Premier of the Commonwealth, and others, had given them the most emphatic assurances that they would spare no effort to see that British capital invested in developing the resources of Australia should be properly protected. They felt so satisfied with those assurances that they were now taking vigorous steps to develop the Adelaide undertaking in the surrounding suburbs. The dividend on their ordinary shares were not very brilliant—only 2½ per cent.—but as far as he could judge, it was likely to be very considerably increased during the current year. The electrification of the Adelaide tramways was being undertaken, and they had received a cable from Mr. Clements, their local managing director and chief engineer, stating that the company's offer to supply the tramways with power had been accepted for a provisional term. In recognition of the extreme care and ability with which Mr. Clements had managed the company's affairs, the board had voted him a honorarium of 100 guineas, which he was sure the shareholders would approve.

MR. R. PERCY SELLON seconded the motion, and the report was adopted.

British Westinghouse Electric and Manufacturing Co., Ltd.

A MEETING of the holders of the 4 per cent. mortgage debenture stock of this company was held on Wednesday, December 18th, at Hamilton House, Victoria Embankment, for the purpose of considering the following resolution: "That this meeting of debenture stock-holders of the British Westinghouse Electric and Manufacturing Co., Ltd., in pursuance and exercise of powers vested in the meeting by clause 4 of the third schedule to the trust deed dated February 18th, 1902, and made between the company of the one part and the Merchants' Trust, Ltd., as trustees, of the other part, and of all other powers the meeting hereunto enabling, doth hereby consent to the postponement of the mortgage and charge created by the said trust deed in favour of a loan about to be raised by the company by means of an issue of £300,000 of prior lien debentures, carrying interest at the rate of not exceeding 6 per cent. per annum, redeemable January 1st, 1933, or at the option of the company at 105 per cent. after January 1st, 1911, and that the Merchants' Trust, Ltd., as trustees of the said trust deed, be, and are hereby, authorised and empowered with a view to effectuating such postponement to concur with the company in making such alterations in the said trust deed, and, or in the debenture stock secured thereby, and, or in carrying out such dealing with or disposition of the property mortgaged or charged thereby as may be necessary to enable such prior lien debentures as aforesaid to be issued with the benefit of a mortgage or charge on such property ranking in priority to the mortgage or charge contained in the said trust deed securing the existing 4 per cent. mortgage debenture stock of the company. And, further, that the Merchants' Trust, Ltd., be and are hereby authorised and empowered to concur with the company in executing a trust deed in the terms of the draft submitted to this meeting, with such amendments, if any, as they may agree to, and any other mortgage or charge that may be necessary in connection with the above-mentioned issue of prior lien debentures, and generally to take all such steps as may be necessary to carry out the object of this extraordinary resolution; and, further, that the Merchants' Trust, Ltd., be and are hereby authorised to act as trustees for the said prior lien debentures."

Mr. Frank Dawes, who presided, was challenged by a debenture-holder as to his title to take the chair.

The CHAIRMAN read a resolution of the board, dated December

12th, stating that in accordance with clause 6 of the third schedule of the trust deed, they had appointed him as chairman of the meeting. With regard to the objects of the meeting, as far as the trustees were concerned, he did not propose to go into the details of the position of the company, because the best people to go into details, if they wished them, were the directors. As far as the trustees were concerned, they must leave it for the debenture-holders to either approve or reject the proposal. He might say that a very considerable amount of support had been accorded the scheme by the debenture-holders who had sent in proxies. They had got to decide whether, in the first place, the money was wanted, and secondly, whether the course now suggested was the best mode of raising it. Undoubtedly the money was required and must be obtained, and they were all aware that during the past few months the times had not been propitious for raising money in the city.

Mr. J. A. Price, a director, then proposed the resolution. He said that the company found itself in the position of not having sufficient money to continue its necessary development. It was necessary, therefore, that more money should be obtained, and it must be apparent to them that under the present condition of affairs the ordinary methods of getting fresh capital by an issue of further shares was quite out of the question. They might say that the directors might have issued further debentures to rank *pari passu* with the existing ones, but they had exhausted all their powers in that respect. The only method, therefore, by which they could obtain what they needed was by the issue of prior lien shares. The business they believed to be a good one. They believed that with nursing, care and energy the company could be brought into a satisfactory paying condition, but it would take time. He did not think that the sum of money which they asked the existing debenture-holders to have put in front of them was one which seriously affected their security, or would hamper the company in any way. Well, as he had said, the business was improving. This year for the first time for some time, they had been able to cover the debenture interest, and leave a small surplus, and he believed that with nursing and care, they would eventually be able to convert the company into a profitable concern. (A voice: "Wind it up.") No, he did not agree with that. The directors had already considered that it would not be in the best interests of the debenture-holders to appoint a Receiver.

Col. Cradock seconded the resolution.

Mr. Torr, who said he was a debenture-holder to the extent of £5,000, remarked that as far as he had been able to gather, the effect of the scheme would be that he and his fellow-holders would lose £300,000, in order to pay off the American company, whose security up to the present moment had been inferior to theirs. At present they held a first mortgage on the freehold property of the company. None of the loans of the American company had stood in advance of their claim, but if they passed the resolution, the claims of the American company would be paid off out of the money that would be raised. In his opinion, the interests of the debenture-holders would be best served by the appointment of a Receiver. They would then get possession of what they had always believed to be their property in the event of their claims not being met by the company, and it would then be for them to say what steps they considered best for raising money. They were absolutely in the dark as to how the business of the company was carried on—the only time their rights became valid was when their interest was not paid. If the money could not be raised by a further issue of shares or by debentures *pari passu* with the existing ones, why could it not be raised by second preference shares or some other charge which, while taking precedence of their rights, would still leave them in possession of them? If the business was in anything like the satisfactory state the directors would like them to believe it was from the circular they had issued, surely it would not be impossible to raise second debentures or preference shares, in either of which cases the rights of the existing debenture-holders would remain intact?

Mr. Fuller said he was very disappointed when Mr. Price sat down without giving them practically any information, for he had hoped that they would have been given a full explanation as to the position of the company. He (Mr. Fuller) had wished to circularise the debenture-holders on the matter, but a request by his solicitor to inspect the register in order to take extracts was refused, and it was only on Saturday last, after he had informed the company that he would take the matter to the Courts, that he was allowed personally to see the register. It was obviously too late then to circularise the debenture-holders, and so in place thereof he had written a letter to the secretary which he would read. Mr. Fuller then read a long letter, which was dated December 14th, in which he stated, *inter alia*, that the American company had a claim as creditors of £185,499, against which, he believed, they held the Clyde Valley shares (which had only a prospective value), and that they were otherwise unsecured. The board supported their request for this issue by saying the Merchant Trust (with a holding of only £20,000 out of £1,241,353 debenture stock) considered the proposed offer the best solution of the present position, but from whose point of view? The American company held £675,000 debenture stock, and as it was clearly to benefit under the scheme, and the Merchants' Trust was a paid trustee for the debenture-holders, they would not be likely to view the matter from the private debenture-holders' standpoint. Mr. Fuller concluded by saying that in his opinion to suggest that they, as first mortgagees, should assist some of the present creditors to be paid appeared to him to be out of all reason and devoid of equity, and he questioned whether any resolution passed at the meeting would be valid in law.

Mr. L. L. Cohen asked what amount of debenture stock was requisite to carry the resolution, and whether it was true that the board held proxies representing £625,000 worth of debenture stock issued to the American Westinghouse Co.

The Chairman said that to constitute the meeting two-thirds of the holdings was requisite, which was £827,568, and to carry the resolution three-fourths of that two-thirds must vote in its favour—that meant £620,676. The total amount of proxies held by the company was £894,529, of which £675,000 was on behalf of the American company.

Mr. Empson said it was clear that the meeting was swamped by the £675,000 votes which the board had received from America. The remainder of that money was invested by men in England who took 4 per cent. because they considered that there was nothing speculative about the investment. In his opinion it was not fair; it was un-English to come before them with such a proposal when the American company, which was interested in carrying it, had sent in sufficient proxies to practically swamp the ordinary investor. He hoped there would be a combination of the English shareholders to fight this thing for all it was worth. The transaction was most unjust and savoured of those methods of American finance with which people had been only too familiar of late.

Mr. Bingham, speaking in opposition to the resolution, said that if there was any reasonable ground for believing that the business could be made to pay, all he could say was, it ought to have been made to pay up to the present. It seemed to him that the thing was a gamble—nearly half a million of the money that was raised had gone to other companies. He was perfectly satisfied that if this £300,000 was raised it would go where all the other money had gone, judging from the unbusinesslike way in which the company had been managed.

Mr. Wynne Evans said he thought they had a right to expect to see the trustees at the meeting to explain why this money was required. Why should they have to stand out of their money in order to pay the American creditors?

Mr. H. Smith said that much as he deplored the necessity for the scheme, he considered it preferable to a receivership. It was quite clear that if they put in a receiver at the present time and had to realise the assets, they would not get 20s. in the £ for their debentures. He agreed that the administration of the company in the past had left a great deal to be desired, but he would remind them that a change was made about a year ago, and the advent of the new managing director had synchronised with a profit instead of a loss on the trading.

Replying to questions, Mr. Price said that no pressure had been brought by the American company in regard to the scheme—in fact, they had had to put pressure upon them to accept it.

Sir James Whitehead asked whether anybody was present representing the Merchants' Trust, and, if so, he would like some explanation as to why they had thrown over the debenture-holders. He also wished to know whether the Merchants' Trust had any interest whatever or of any kind in the company other than as trustees for the debenture-holders, and further, as they were to be the trustees of the new trust, what remuneration they were to receive.

The Chairman said he was there representing £20,000 worth of debentures owned by the Merchants' Trust. He submitted that it was not reasonable to suppose that they were willing to throw over their interest in that sum, unless they thought that the best and wisest course was to support the scheme. The remuneration of the trustees would be £50 a year. The Merchants' Trust held in addition £10,250 in preference and £1,000 in ordinary shares.

Mr. Torr moved the adjournment of the meeting till January 25th, and this on a show of hands was carried by 19 votes to 8.

Mr. Price thereupon demanded a poll, which was at once proceeded with, and resulted in the amendment being defeated by a large majority.

On a show of hands the original resolution was also lost, and in this case also a poll was demanded, with the result that the Chairman declared the resolution to be carried.

D. Santoni & Co. (1907), Ltd.

A meeting of creditors of this company was held on Friday last at 64, Chancery Lane. Mr. Ronald Power presided, and there was a large attendance.

The Chairman said the creditors had been called together by the directors for the purpose of receiving a statement as regarded the present position of the company, and incidentally for the purpose of discussing the best means of meeting that position. The cause of the difficulties in which the company found itself was, in the first place, the extreme difficulty they had experienced in getting in their accounts. They were owed something like £6,000, which they found it exceedingly difficult to get in. That shortage of cash meant that from time to time they had not been in a position to meet the accounts of some of their customers as they became due, although he wished to acknowledge that they had received the greatest consideration from the majority of the people with whom they were dealing. They found themselves in that position towards the end of last month, and one of their supply houses proceeded to sign judgment against them and levy execution. As a result of that, the debenture holders appointed a Receiver. The directors then got into touch with about 40 or 50 of the larger creditors, and convened a meeting for the purpose of dealing with the position, which at that time had got very acute, as the creditor had threatened to put a petition on the file to wind up the company. He (Mr. Power) suggested to the creditors that if the company was to go into liquidation, it would be better that it should be done voluntarily than compulsorily. Subsequently to the meeting several names were submitted by creditors as likely people for the post of liquidator, and the name which appeared to meet with most favour was that of Mr. J. H. Duncan, chartered accountant, of 39, Coleman Street. He (the chairman) called about 12 or 15 of the largest

shareholders together, and submitted Mr. Duncan's name to them, and he also sent his name to the principal creditor at Nuremberg, and about two-thirds of the total indebtedness of the company had signified their assent to Mr. Duncan's appointment. Proceeding to figures, Mr. Power said that they took stock on the 30th of last month. The book debts were taken as at that date, and as regarded the other items, furniture, fittings, &c., they were taken from the balance-sheet which was made up to June last. The trade debtors were £6,084; stock in hand, £6,409; plant, machinery and tools, £635; factory fittings, office furniture, &c., £1,277: goodwill £3,908; total, £18,243. On the liability side the unsecured creditors on open account were £10,115; bills payable, £2,787; debentures, £4,950; interest accrued, £50; preferential creditors for rent, £150—a total of £18,053, which left an estimated surplus of £190. That, of course, was showing the position of the company as a going concern. They had had a scheme of reorganisation before them for some considerable time, and about six weeks ago they had an opportunity of acquiring a factory near London at a very low price, which would just have suited them, and which they could have acquired with plenty of work in it. He thought that would be a very good opportunity for reorganising the whole concern, and he was hoping to get financial assistance to the extent of about £30,000, when this unfortunate occurrence took place; the scheme was still on the *tapis* and he had very good hopes that if the creditors worked with the directors, and if they all worked harmoniously together with the object of trying to save the money that was in the company, he would be able to bring that scheme through. It was perfectly obvious, however, that they could do nothing if they were to meet with opposition from the creditors. Immediate liquidation would be an undesirable step—not only would it cause the determination of important contracts which they had in hand, but it would materially affect the company's credit. He would suggest that the best course would be for them to agree to the principle of a voluntary liquidation, but postponing the matter until they saw what resulted from the negotiations to which he had referred, for raising fresh capital. In the meantime they might appoint a committee which should look after the interests of the creditors.

A long discussion ensued, and replying on the same, the Chairman said that £2,750 of the debentures were controlled by himself, being in the name of his wife. He was the London manager and director of the company, and if they would allow him to do his best to bring the company through its difficulties and put it on its legs again, he would continue the negotiations that were now in progress for getting in additional capital, but he must have the sympathy and co-operation of the creditors in the matter. If he could not get the support of the creditors, they must take the concern into their own hands, after the debentures had been paid off. He could promise them that he would father no scheme of reorganisation which did not provide for the creditors receiving 20s. in the £. He wished it to be distinctly understood that he did not promise any scheme, but would do his best to get it through. He declined to give the turnover of the company, but he could tell them that it had doubled itself since August.

Ultimately the following resolutions were carried *nem. con.*:—"That this meeting of creditors of D. Santoni & Co. (1906), Ltd., is opposed to a compulsory winding-up of the company and will support a voluntary winding-up with Mr. J. H. Duncan as voluntary liquidator, but it is the opinion of the meeting that it is desirable to postpone liquidation pending negotiations for raising fresh capital." "That a committee of the five following creditors, Mr. Turner, Mr. Günther, Mr. Bailey, Mr. Bateman and Mr. Rooke be re-appointed, with power to add Mr. Neu to this number, and be empowered to employ Mr. J. H. Duncan to act as accountant to the creditors, and that the expenses of such committee and said accountant be paid by the company."

The Underground Electric Railways Co. of London.

The fifth annual meeting of the shareholders of this company was held on Monday at Hamilton House, Victoria Embankment, Sir Edgar Speyer, the chairman, presiding.

In moving the adoption of the report (see Electrical Review, December 20th, page 1024), the Chairman said they hoped early in the New Year to put before the shareholders a scheme for dealing with the company's finances, when he would explain the proposals in detail. Under those circumstances, he thought it was in the best interests of the company that he should reserve his remarks until then, and that the present meeting should be adjourned until some date early in the New Year, when they would be called together to consider the scheme.

Lord George Hamilton seconded the motion, and the report was adopted.

The retiring directors and auditors having been re-elected, the proceedings, which did not occupy more than two or three minutes, terminated.

Germany.—The Siemens Schuckertwerke Gesellschaft reports a net profit of £508,276 for the last financial year, an increase of £58,340 over the preceding 12 months. The Schuckert Co. is declaring a dividend of 5 per cent., and the Siemens-Halske Co. one of 11 per cent.

Liverpool Electric Cable Co., Ltd.—The annual general meeting of the company was held at Liverpool on the 20th inst., when a dividend of 7½ per cent. was declared.

STOCKS AND SHARES.

Saturday Afternoon.

With the closing of the Stock Exchange at one o'clock to-day, Saturday, business virtually shuts down on what one facetious jobber calls the sunny side of Christmas. The last few days have been so quiet that the markets might almost as well have been closed; and although the official recess consists only of Christmas Day and Boxing Day, it is quite certain that a good many departments will, for all practical purposes, be suspended during the whole of the week.

Home Railway stocks have been benefited by Lord Allerton's speech at the Great Northern meeting last Friday, in the course of which he threw out hints of a closer union of railway interests generally, taking the new agreement between his own company and the Great Central as the text of his prophetic utterance. The electric railways have, of course, been gradually working towards a state resembling a community of interests for the past year or two, drawn together by the bond of common affliction which over-competition has laid upon them. Electrical Railway issues have hardly moved, but there is a good deal of speculation as to what the dividend on Central London Deferred is likely to be. Estimates vary from 1½ to 2½ per cent., the distribution, as usual, being for the full year.

Telegraph stocks and shares are fairly firm, although there was a slight pressure to sell Globe Telegraph and Trust Ordinary, despite the dividend of 2s. per share. West India and Panama Preferences are picking up again, and 2s. 6d. rises in the Ordinary and Preference have taken both Preference issues to about 7¼. The Eastern and the Anglo-American divisions are unusually quiet, while in the Telephone group the only alteration is a slight improvement in National 3½ per cent. Debenture stock.

Electricity Supply shares show rises of 5s. in County of London Electric Preference, and half that amount in Urban Ordinary shares. St. James's Preference are not quite so good, though still retaining part of their last week's rise. Other shares in the list are as motionless as ever.

After a somewhat dramatic rise of 8 points, Sao Paulo Tramway, Light and Power Ordinary stock has relapsed 5, falling to 114. Sunderland District Electric Tramways Debentures are again flatter at 79, exhibiting a further 2 points loss. Isle of Thanet Electric Tramways and Lighting Preference shares changed hands at 20s. the other day, and British Electric Traction Ordinary were done at 31s. Anglo-Argentine Tramway Preference continue strong, but British Columbia Preferred Ordinary shed 2 per cent. of its improvement and returned to 107.

Victoria Falls Power Preference shares, which have recently been admitted to official quotation in the Stock Exchange daily list, are called 10s. to 12s. 6d. It is not difficult to buy them.

Attention is a good deal concerned with Mexico at the present time on account of the rearrangement of railway freights which it is proposed to carry out, and there has also been quiet buying of one or two Mexican electric descriptions. The 5 per cent. First Mortgage bonds of the Mexican Light and Power Company are about 84, the capital stock standing at 44. The 5 per cent. Gold bonds of the Mexican Electric Lighting Company are called 76 to 78. Canadian General Electric, the company hailing from the same stable as the Mexican Light and Power, has its common shares about par, and Electrical Development Company of Ontario 5 per cent. First Mortgage bonds were done at 74 on Friday last.

Competition.—The Automobile Club of Milan is holding a competition, the prizes to be adjudicated upon during the spring, 1908, for the best means of lighting motor-cars. The competition is divided into three parts: (1) The best generator; (2) the best lamp; (3) the best system for lighting motor-cars. The Executive Committee consists of Messrs. Silvio Crespi (president), Fazio dal Pozzo, Dr. Alberto Pirelli, Luigi Brigatti and Count Carlo Sormanni.

France.—The Association des Industriels de France Contre les Accidents du Travail, a combination of French manufacturers founded with the object of minimising accidents arising from defective machinery and during the process of work, has accorded the following prizes:—(1) Primary elements—Messrs. Leclanché & Co., £140; Messrs. Rousselle et Tournaire, hon. mention and £40; (2) accumulators—Société Anonyme pour le Travail Electrique des Métaux, £120.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING NOVEMBER, 1907.

The electrical business of the above month shows a recovery in value as regards exports, and a slight fall on the part of the imports; the re-imports remaining practically stationary.

Thus, the November exports from Great Britain amounted to £184,641, an amount which compares with £171,427 in the preceding month; the imports at £158,884 were some £3,000 lower than in October, and the re-imports amounting to £21,776, some £700 higher.

That these figures show very satisfactory progress is best seen by comparison with previous averages, which in 1906 were for the exports, 134; imports, 147; and the re-exports, 12·8 thousands respectively; and during the first nine months of the present year were, for the exports, 161·6 and imports, 154 thousands respectively.

An exceptionally good return is shown in the electrical machinery export section, which reached some £87,000 in value; cable exports also maintained a high value, amounting to £48,010.

As regards the import section, machinery, cables, and particularly telephone material, show considerable reduction in value, compared with the normal.

Our most valuable customer during the month was our Indian empire, New South Wales and Japan coming second and third respectively; Holland figures as the most prominent importer into this country, not necessarily, of course, of its own products.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.*

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material, and electric bells.	Electrically-driven machinery.	Tramways apparatus and materials.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	382	977	140	35	11	3,748	110	...	97	56	...	5,556
Germany	396	1,826	113	39	...	863	12	32	50	...	...	3,331
Netherlands	66	753	330	20	...	784	...	4	...	...	...	1,957
Belgium	255	216	107	41	78	1,499	100	87	908	...	...	3,291
France	688	...	525	147	23	1,829	66	42	5	...	...	3,325
Portugal, Madeira Portuguese Africa	464	280	71	68	200	1,053	...	6	...	...	...	2,142
Spain	66	209	9	66	6	201	...	...	3	...	...	560
Italy, Austria and Greece	110	...	93	21	...	3,094	...	...	163	...	...	3,481
Channel Isles, Gibraltar and Malta	306	45	98	13	...	2,423	...	5	55	11	...	2,956
U.S.A.	58	350	6	...	...	113	...	...	...	...	...	527
Canada	21	250	560	56	11	205	65	...	104	...	...	1,272
British West Indies	...	...	17	4	...	137	...	...	54	3	...	215
Mexico, Venezuela, Peru and Uruguay ...	102	...	141	61	...	3,886	5	...	25	...	...	4,220
Chile	285	203	180	332	...	2,677	10	...	...	...	...	3,687
Brazil	460	401	699	404	12	3,488	451	20	...	...	...	5,935
Argentine	4,761	2,637	116	524	424	8,681	255	12	108	110	...	17,628
												2,084
Egypt	282	61	260	72	25	1,335	8	4	...	37	...	
British West Africa	...	52	...	99	...	38	...	...	50	...	...	239
Cape of Good Hope	479	1,218	145	348	501	5,937	35	4	23	...	...	8,690
Natal	346	3,788	766	322	521	1,226	67	46	176	64	...	7,322
Zanzibar, Brit. East Africa and Mauritius ...	53	8	275	27	...	34	19	...	61	...	...	477
												4,121
China and Siam	444	181	900	200	...	2,367	17	...	12	...	...	
Japan	2,397	3,546	283	...	806	8,519	258	...	225	790	...	16,824
Java and Dutch Borneo...	568	...	25	18	...	...	...	...	70	...	...	681
India...	2,751	4,567	3,492	1,585	629	6,886	1,086	141	129	3,779	437	25,482
Burmah	223	3,197	922	161	...	452	9	...	17	56	...	5,037
Ceylon	215	159	43	14	25	759	37	...	18	...	...	1,270
Straits Settlements, Fed. Malay States, and Labuan	462	696	358	26	7	140	35	5	5	...	...	1,714
Hong Kong	...	104	145	...	...	356	...	25	22	130	...	792
West Australia	223	389	313	209	...	2,073	133	7	44	78	...	3,469
South Australia	422	14	132	...	54	1,707	26	...	...	...	...	2,355
Victoria	378	6,590	445	251	61	4,022	44	...	4	...	...	11,795
New South Wales	1,891	12,138	296	687	44	1,607	91	14	120	466	...	17,354
Queensland	359	1,002	15	25	31	260	...	...	...	...	...	1,692
Tasmania	...	...	19	69	...	7,116	...	...	...	...	...	7,204
New Zealand	272	2,153	1,275	32	25	1,996	164	...	6	16	...	5,939
Total, £	20,185	48,010	13,314	5,976	3,494	81,511	3,103	454	2,554	5,596	437	184,634

Additional export: Algeria, £7.

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Norway, Sweden and Denmark ...	18	815	...	50	...	560	303	...	4,236	...	...	5,982
Germany	184	3,828	1,248	10,864	21	17,282	479	1,425	1,687	...	...	37,018
Holland	243	9,969	501	15,946	772	5,140	718	8,317	1,234	6,995	...	49,835
Belgium	479	5,032	115	4,805	257	5,833	268	1,476	7,612	1,060	...	26,937
France	490	7,330	3,572	932	1,532	1,534	18	3,984	86	...	...	19,478
United States	2,022	713	783	797	...	12,318	...	1,329	500	1,172	..	19,634
Total, £	3,436	27,687	6,219	33,394	2,582	42,667	1,786	16,531	15,355	9,227	...	158,884

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above	4,736	4,977	310	429	1,342	8,683	...	401	677	221	...	...

Total Exports: £184,641 Total Re-Exports: £21,776 Total Imports: £158,884

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

* This section does not include telegraph cables and apparatus.

THE INFLUENCE OF THE RATED SPEED AND OUTPUT ON THE DESIGN OF CONTINUOUS-CURRENT GENERATORS.

By H. M. HOBART, M.Inst.C.E., and A. G. ELLIS, Assoc. A.I.E.E.

(*Concluded from page* 1032.)

In making such an investigation, in order to readily compare the leading constants for a given rated output, but at different rated speeds, considerable assistance may be derived from plotted curves of the various quantities involved. Let us, for example, endeavour to ascertain the most economical speed for a 250-KW. 250-volt continuous-current generator.

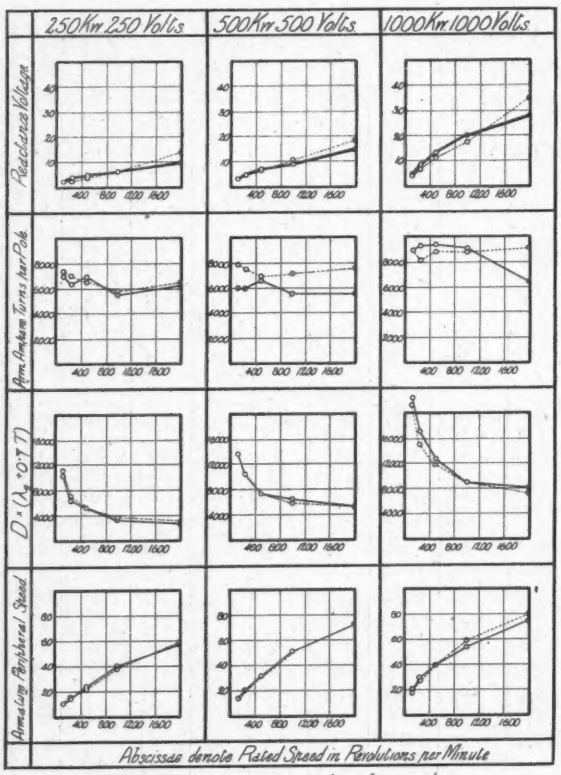

250 Kw. 250 Volts
500 Kw. 500 Volts
1000 Kw. 1000 Volts
Reactance Voltage
Amp. Ampere Turns per Pole
D = (λ + 0·7 T)
Armature Peripheral Speed
Abscissae denote Rated Speed in Revolutions per Minute
Worked designs by calculation are shown by —— line
Designs chosen from Chart are shown by ------ line

Fig. 6.—Curves showing the Relative Values of Technical Data obtained from the Designs by Chart Method in Tables 6, 7 and 8, and Designs given in Specification in Table I.

In fig. 4 is plotted the total works cost in shillings for generators of this output and voltage, as a function of the rated speed in R.P.M.

The minimum value of the total works cost is observed to occur at the rated speed of 1,500 R.P.M., and may be taken as some 16s. per KW., or £200 total.

Fig. 4 also shows the cost of effective material at 1,500 R.P.M. It amounts to some 4s. per KW. The cost of effective material does not reach a minimum value on the curve as drawn. Beyond the rated speed of 1,500 R.P.M., however, the decrease is but slight.

Thus the total cost of effective material for the 250-KW. 250-volt dynamo is 4·0 × 250 = 1,000/- = £50.

The total weight of effective material expressed in kilogrammes per kilowatt reaches its minimum value at 2,000 R.P.M., as shown by the curve in fig. 4.

The weight of effective material for a 250-KW. dynamo at a rated speed of 1,500 R.P.M. (fig. 4) is about 10 kilogrammes per kilowatt, hence the total weight of effective material amounts to 250 × 10 kg. = 2,500 kg. = 2·5 metric tons.

From fig. 5 it is seen that at a rated speed of 1,500 R.P.M. a value of some 8 reactance volts is obtained. This is a moderate value for an interpole machine of the rated output under consideration.

The armature heating expressed in watts per square decimetre at the rated speed of 1,500 R.P.M. is about 75 (from the curve in fig. 6). This value need not lead to an excessive temperature rise, as with an armature peripheral speed of 48 metres per second, an excellent circulation of air may

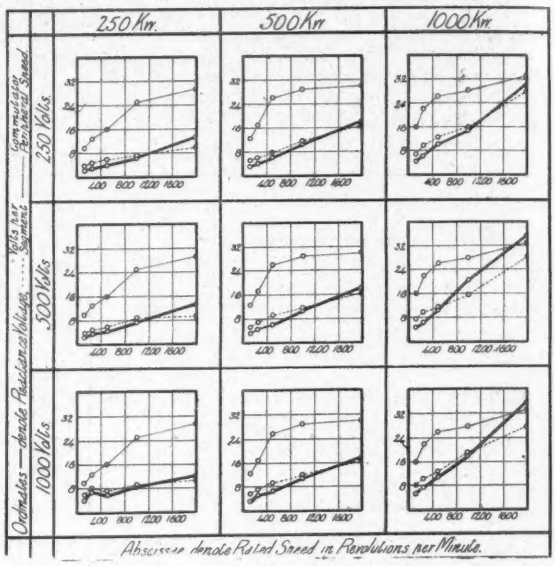

250 Kw.
500 Kw.
1000 Kw.
Ordinates — denote Reactance Voltages ..... Volts per Segment —— Commutator Peripheral Speed
250 Volts
500 Volts
1000 Volts
Abscissae denote Rated Speed in Revolutions per Minute.

Fig. 7.—Curves showing Values of Reactance Voltage, Volts per Segment, and Commutator Peripheral Speed for 45 Preliminary Designs for Continuous-current Generators of various Rated Outputs, Voltages and Speeds.

be maintained, provided there be a sufficiently large internal diameter of armature and sufficiently numerous ventilating ducts in the core.

The principal constants and data of the 250-KW. 250-volt machine at the most economical rated speed—namely, 1,500 R.P.M.—are contained in Table II.

In Table II are also contained leading constants for 500-KW. 500-volt, and 1,000-KW. 1,000-volt, designs deduced from the curves in figs. 4 and 5.

The minimum Total Works Cost for a dynamo of 500 KW. rated output occurs at a rated speed of about 1,000 R.P.M. In the case of the 1,000-KW. machine, the minimum total works cost occurs midway between 500 and 1,000 R.P.M., and is taken at 750 R.P.M.

TABLE II.—Technical Data and Cost of 250, 500 and 1,000 KW. Continuous-current Generators.

Rated output, KW.	250	500	1,000
Terminal voltages	250	500	1,000
Rated speed, R.P.M.	1,500	1,000	750
Total Works Cost in shillings...	3,840	9,200	16,800
Cost of effective material in shillings per KW.	4·0	7·6	7·0
Weight of effective material in kg. per KW.	10	12	11·5
Armature peripheral speed in metres per second	42	50	45
Commutator " " " " " "	26	30	30
Reactance voltage	8	9	16
Watts per sq. dcm. of armature surface ...	76	85	85
Efficiency at full rated load	94·0 %	94·7 %	95·2 %

The most economical speeds consistent with good designs for these different outputs may thus fairly be taken somewhat as follows :—

250 KW.	1,500 R.P.M.
500 KW.	1,000 R.P.M.
1,000 KW.	750 R.P.M.

The steam turbines at present in use for corresponding outputs run at much higher speeds. These speeds are approximately as shown in Table III.

TABLE III.

Kilowatts output.	Speeds in revolutions per minute.		
	Economical speed of continuous-current generator.	Curtis type turbines.	Parsons type turbines.
250	1,500	2,200	3,000
500	1,000	1,500	2,500
1,000	750	1,000	2,000
2,000	500	750	1,250

In this table it is shown that, for a continuous-current dynamo of given capacity, the corresponding economical speed is approximately equal to the speed of a Curtis turbine of twice the rated output.

Hence, where direct-coupled, steam-turbine-driven, continuous-current sets are required an obvious plan consists in employing two dynamos direct-coupled to one turbine, the turbine being of sufficient rated output to drive the dynamos when both are fully loaded, and to meet all requirements of overload during the specified time.

In a large continuous-current generating station, this arrangement of coupling two continuous-current dynamos on

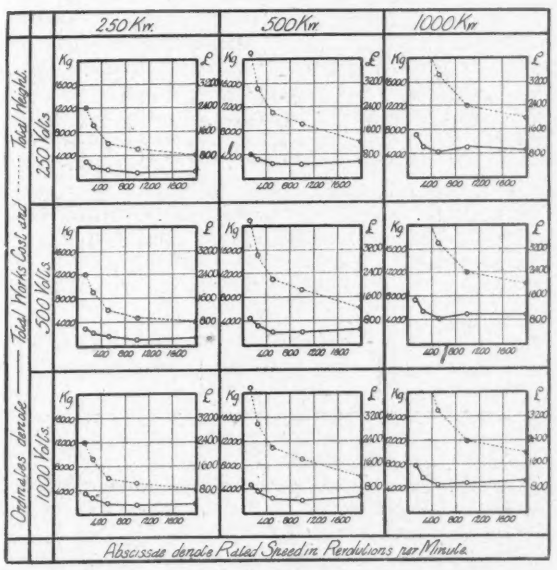


Fig. 8.—Curves showing Values of Total Works Cost in £ and Total Weight in kg for 45 Preliminary Designs for Continuous-current Generators of various Rated Outputs, Voltages and Speeds.

one turbine shaft has, amongst other obvious drawbacks, the disadvantage of complicating the switchboard arrangements, and increasing the amount of supervision required owing to the large number of electrical generating units required.

For a lighting station with a widely varying load, the increased number of relatively smaller machines can be turned to good account by improving the all-day efficiency.

In Table IV are set forth the efficiencies of 250, 500 and 1,000-kw. continuous-current generators at full, half and quarter load.

TABLE IV.—Efficiencies of C.C. Generators at Different Loads.

	Full-load.	½-load.	¼-load.
250 kw.	94·0 %	90·0 %	84·0 %
500 kw.	94·7 %	92·0 %	86·0 %
1,000 kw.	95·2 %	93·5 %	88·0 %

Let us take the case of a continuous-current turbine set with a rated output of 1,000 kw. Table V shows the dynamo efficiencies of two sets of this output, the one employing one dynamo of 1,000-kw. rated output, and the other employing two dynamos of 500-kw. rated output respectively.

TABLE V.—Efficiencies of 1,000-kw. C.C. Turbo Set.

	Employing one dynamo.	Employing two dynamos.
Efficiency at full load	95·2	94·7
„ „ half load	93·5	94·7
„ „ quarter load ...	88·0	92·0

From this table it is seen that the efficiency is considerably improved on light loads by using the turbine set with two dynamos.

These efficiencies are, of course, based on the assumption that, at one-half the rated load and at less loads, one of the

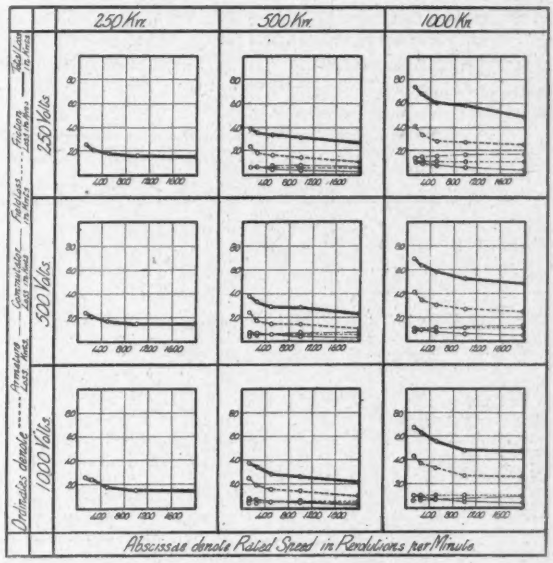


Fig. 9.—Curves showing Values of Armature Loss, Commutator Loss, Field Loss, Friction Loss, and Total Losses for 45 Preliminary Designs for Continuous-current Generators of various Rated Outputs, Voltages and Speeds.

500-kw. machines is switched out, its field circuit opened, and its brushes raised.

The designs given above, and on which we have based these comparisons, have been obtained by working out each design individually to a fair degree of detail, independently of the method described in the article in the Electrical Review for September 6th, 13th and 20th, 1907, as was stated at the beginning of the present article. We have, as a check on the general method, obtained the leading data of these designs also from the chart given in fig. 7 of the previous article, and compared the data obtained by both methods, in fig. 6.

In Table IX of the previous article we obtained leading data for 500-kw. 250-volt machines derived from the chart in fig. 7, at the rated speeds of 125, 250, 500, 1,000 and 2,000 r.p.m.

In Table VII these data have been incorporated together with similar data for 500 and 1,000-volt designs of the same rated speeds. In a similar way we have also obtained corresponding data for 250 and 1,000-kw. designs at 250, 500 and 1,000 volts and for the same rated speeds. We have in fig. 6 selected the 250-kw. 250-volt, 500-kw. 500-volt, and 1,000-kw. 1,000-volt designs from Tables VI, VII, and VIII. The data of these designs, obtained from the chart, are plotted in the dotted-line curves in fig. 6; the full-line curves indicate the results of the designs worked out in this article by the ordinary detailed procedure.

The curves show the following quantities plotted against the rated speed:—Reactance voltage; armature strength—ampere-turns per pole; $D \times (\lambda_y + 0{\cdot}7\,\tau)$—(which is a measure of the Total Works Cost); armature peripheral speed. On the whole, the curves are in good agreement with each other, the chief differences occurring at the higher rated speeds, and even then they are relatively slight in magnitude. This comparison affords evidence of the usefulness of the method described in the previous article as a ready means of arriving at a sound preliminary design for a continuous-current dynamo.

TABLE VI.—Designs for 250-kw. Continuous-current Dynamos, for 250, 500 and 1,000 Volts at Different Rated Speeds. (These designs were obtained from the Chart of Fig. 7 on p. 442 of the Electrical Review for September 13th, 1907.)

Rated speed in revs. per minute...		125			250			500			1,000			2,000		
Voltage		250	500	1,000	250	500	1,000	250	500	1,000	250	500	1,000	250	500	1,000
No. of poles...		10	8	8	8	6	6	6	6	4	6	6	4	4	4	2
Cycles per second		10·5	8·4	8·4	16·8	12·6	12·6	25	25	16·8	50	50	33·6	67	67	33·6
Armature diameter... ...	D	160	150	170	120	110	130	85	90	75	75	60	60	55	55	50
Gross core length	λ_g	30	34	26	28	35	24	31	28	41	24	37	37	30	30	35
Polar pitch	τ	50	59	67	47	58	69	44	47	59	39	32	47	43	43	79
$D \times (\lambda_g + 0{\cdot}7\,\tau)$		10,400	11,000	12,500	7,200	8,300	9,200	5,200	5,400	6,000	3,800	3,600	4,200	3,300	3,300	4,500
$\lambda_g \div \tau$		0·6	0·58	0·39	0·6	0·61	0·35	0·7	0·6	0·7	0·61	1·15	0·8	0·7	0·7	0·43
Armature peripheral speed	S_a	10·5	10	11	16	14	16·5	22	23·5	20	38	30	30	59	59	53
Armature ampere-turns per pole...		7,500	8,800	10,000	7,000	8,700	10,300	6,600	7,000	8,800	5,800	4,800	7,000	6,500	6,500	11,800
Amperes per circuit		100	63	31	125	84	42	167	84	63	167	84	63	250	125	125
Turns per pole	T	75	140	320	56	103	246	40	83	140	35	57	110	26	52	95
Turns per segment...		1	1	2	1	1	2	1	1	1	1	1	1	1	1	1
Total No. of commutator segments		750	1,120	1,280	448	618	738	240	498	560	210	342	440	104	208	190
Width of (segment + insulation)...		0·50	0·35	0·35	0·50	0·50	0·50	0·50	0·50	0·35	0·50	0·50	0·35	0·50	0·50	0·70
Commutator peripheral speed ...		8·0	8·4	9·5	9·4	13	15·5	10	21	15·5	17	28	25	17	34	32
Reactance voltage		2·3	2·4	4·0	3·0	3·7	7·0	4·0	4·4	5·8	6·5	7·8	8·5	13	13	12

TABLE VII.—Designs for 500-kw. Continuous-current Dynamos for 250, 500 and 1,000 Volts at Different Rated Speeds. (These designs were obtained from the Chart of Fig. 7 on p. 442 of the Electrical Review for September 13th, 1907.)

Rated speed in revs. per minute...		125			250			500			1,000			2,000		
Voltage		250	500	1,000	250	500	1,000	250	500	1,000	250	500	1,000	250	500	1,000
No. of poles...		16	12	10	12	10	8	10	8	8	6	6	6	4	4	4
Cycles per second		16·8	12·6	10·5	25	21	16·8	42	33·6	33·6	50	50	50	67	67	67
Armature diameter... ...	D	230	200	190	170	160	150	135	120	120	95	95	90	70	70	70
Gross core length	λ_g	24	32	34	26	30	34	25	30	30	29	29	32	33	33	33
Polar pitch	τ	45	52	60	44	50	58	42	46	46	49	49	46	55	55	55
$D \times (\lambda_g + 0{\cdot}7\,\tau)$		12,600	13,600	14,400	9,800	10,500	11,000	7,300	7,400	7,400	5,900	5,900	5,900	5,100	5,100	5,100
$\lambda_g \div \tau$		0·54	0·62	0·57	0·6	0·6	0·6	0·6	0·65	0·65	0·6	0·6	0·7	0·6	0·6	0·6
Armature peripheral speed	S_a	15	13·0	12·5	22	20	18	35	32	32	50	50	45	72	72	72
Armature ampere-turns per pole ...		6,700	7,800	9,000	6,600	7,500	8,700	6,300	6,900	6,900	7,300	7,300	6,900	7,600	7,600	7,600
Amperes per circuit		125	83	50	166	100	62	200	125	62	333	166	83	500	250	125
Turns per pole	T	53	94	180	40	75	140	32	55	110	22	44	83	15	30	60
Turns per segment...		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total No. of commutator segments		848	1,130	1,800	480	750	1,120	320	440	880	132	264	498	60	120	240
Width of (segment + insulation)...		0·50	0·50	0·35	0·50	0·50	0·35	0·50	0·50	0·35	0·50	0·50	0·35	0·50	0·50	0·35
Commutator peripheral speed	S_c	9·0	12	12·5	10	16	16	13·5	19	26	11	22	29	10	20	28
Reactance voltage		2·8	3·0	3·0	4·3	4·6	4·8	6·0	6·5	6·5	10·5	10·5	10·6	18	18	18

TABLE VIII.—Designs for 1,000-kw. Continuous-current Dynamos for 250, 500 and 1,000 Volts at Different Rated Speeds. (These designs were obtained from the Chart of Fig. 7 on p. 442 of the Electrical Review for September 13th, 1907.)

Rated speed in revs. per minute ...		125			250			500			1,000			2,000		
Voltage		250	500	1,000	250	500	1,000	250	500	1,000	250	500	1,000	250	500	1,000
No. of poles...		20	16	14	16	14	12	12	10	8	8	8	6	6	4	4
Cycles per second		21	16·8	14·7	33·6	29·4	25	50	42	33·6	67	67	50	100	67	67
Armature diameter... ...	D	320	290	270	225	225	212	175	162	150	135	135	110	76	76	76
Gross core length	λ_g	27	32·5	37	30	30	34	26·5	31	36	26·5	26·5	39	56	56	56
Polar pitch	τ	50	57	60	44	50	55	46	51	60	53	53	58	40	60	60
$D \times (\lambda_g + 0{\cdot}7\,\tau)$		20,000	21,000	21,400	13,700	14,600	15,200	10,300	10,800	11,700	8,600	8,600	8,800	6,400	7,400	7,400
$\lambda_g \div \tau$		0·54	0·57	0·62	0·69	0·6	0·62	0·58	0·61	0·6	0·5	0·5	0·67	1·4	0·94	0·94
Armature peripheral speed	S_a	20	18·5	17·5	27·5	27·5	27	46	43	40	72	72	58	80	80	80
Armature ampere-turns per pole ...		7,500	8,500	9,000	6,600	7,500	8,200	6,900	7,600	8,800	7,900	7,900	8,700	6,000	9,000	9,000
Amperes per circuit		200	125	72	250	143	83	333	200	125	500	250	167	670	500	250
Turns per pole	T	38	68	125	26	52	100	20	38	70	16	32	52	9	18	36
Turns per segment		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Total No. of commutator segments		760	1,090	1,750	416	730	1,200	240	380	560	128	256	312	54	72	144
Width of (segment + insulation)...		0·50	0·50	0·45	0·50	0·50	0·50	0·50	0·50	0·50	0·50	0·50	0·50	0·50	0·50	0·50
Commutator peripheral speed	S_c	8·0	11·5	16·5	8·8	15	25	10	16	24	11	22	26	9·0	12	24
Reactance voltage		4·2	4·4	4·6	6·0	6·3	7·0	9·4	10·4	11	14·5	20	17·5	30	35	35

Having thus checked and justified the preliminary method of general procedure, it is now proposed to consider the data of the 45 preliminary designs set forth in Tables VI, VII and VIII, and to plot some of these data. Thereby we shall obtain a fairly comprehensive idea of the influence of the rated output, speed and voltage of the design.

While a considerable number of other quantities of interest could be plotted, we have plotted the following as being of principal interest :—

Fig. 7.—Reactance voltage ; volts per segment ; commutator peripheral speed.

Fig. 8.—Total weight ; Total Works Cost.

Fig. 9.—Armature loss ; commutator loss ; field loss ; friction loss ; total loss.

Fig. 10.—Efficiency at full load, half-load and quarter-load.

Fig. 7.—The reactance voltage increases with the rated speed and output, and, in the larger rated outputs, increases with the voltage. The average voltage per segment also varies in a similar manner. The commutator peripheral speed increases with the rated speed, and is higher in machines of larger rated output. In no case has a peripheral speed higher than 35 metres per second been employed, as this is the highest desirable limit for commutators, and already involves sufficiently grave disadvantages.

Fig. 8.—The total weight and the Total Works Cost decrease with increasing speed. At first, in the lowest speeds, the rate of decrease is appreciable, but when higher speeds are

reached, it is much less appreciable. As observed above, there is a certain speed for each rated output, at which the Total Works Cost is a minimum. The speed at which this is the case, for each of the rated outputs considered, is clearly brought out by the curves, and these results are in fair agreement with those obtained earlier for the more detailed outline designs.

Fig. 9.—The total losses are, of course, greater, the higher the rated output, and rather higher for the lower voltage designs. As all the curves have been plotted to the same scale for the purpose of comparison, it is impracticable to show curves for the various losses in the case of the 250-kw. designs owing to their relatively small value. The

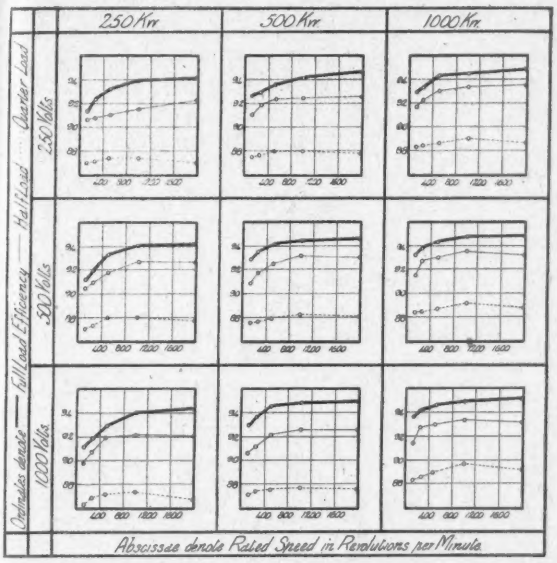


Fig. 10.—Curves showing Values of Full-load, Half-load and Quarter-load Efficiencies for 45 Preliminary Designs for Continuous-current Generators of various Rated Outputs, Voltages and Speeds.

point of interest is the relatively small difference between the value of the total losses for a given rated output over the whole range of speeds. Hence we find that the efficiency is not much lower at low speeds, as will be seen from the curves in fig. 10. A great deal of valuable information is embodied in these curves, and they will bear considerable study, which, however, could not be rendered appreciably more profitable by anything more which could be concisely said in the text.

It must be impressed on the reader that none of the designs of these groups are to be regarded as more than superficial and preliminary. Although a large amount of time has been devoted to their preparation, nevertheless no experienced designer, when in receipt of a requisition for a design of some specified rating, would send off any design he may, by chance, have among his notes, although such a design may be used as a preliminary basis from which to derive a final design. It is in this light that the designs given here should be regarded. Taken with these distinct qualifications, however, this large group of designs is useful, but the main purpose of its preparation was that of obtaining a broad view of the varying influence of the two main factors of rated output and speed, and of the third and hardly less important factor of rated voltage.

In fact, certain of these designs would actually give distinctly poor results, as is apparent from the data set forth in Table I. This, however, has not deterred us from including these ratings in our collection, as the demonstration of the dependence of the degree of inferiority upon the rated output and speed has been a main object of the investigation. The writers have prepared designs in which these points of inferiority are considerably modified, but these designs involve departures from routine methods, and are of a nature justifying their exclusion from the present investigation.

THE USE OF ELECTRICITY IN THE MANUFACTURE OF ARMOUR PLATES.

By J. W. WARR, A.M.I.E.E.

The compound armour plate to which our Admiralty clung so tenaciously for a number of years has practically passed into the region of history, being entirely replaced by cemented steel, which offers greater resistance to penetration and has a harder surface than the best compound armour.

Cemented armour is a special steel, the original process being due to Harvey, which is for the most part now followed by manufacturers.

The steel is melted in a Siemens open hearth furnace and afterwards run into ingot moulds. When the steel has solidified, the mould, which is slightly tapered, is drawn over the ingot whilst hot. The ingot mould weighs about 80 tons and the ingot 50 tons.

The tapered ingot is taken to the press shop and placed under the hydraulic press, where it is shaped rectangular. When the steel is not compressed in its fluid state it is necessary to cut off from the upper part of the ingot about 30 to 40 per cent. of the length in order to reach the sound portion towards the base, and for this purpose the press is also used.

From the press the shaped ingot is taken to the rolling mill to be rolled into plates of varying thicknesses, widths and lengths, according to requirements.

The rolled plate is conveyed to the cementation department to have the surface (which is exposed to the projectile) hardened by a cementing process. The plate is fixed on the movable hearth of the gas furnace, shown in fig. 1, and

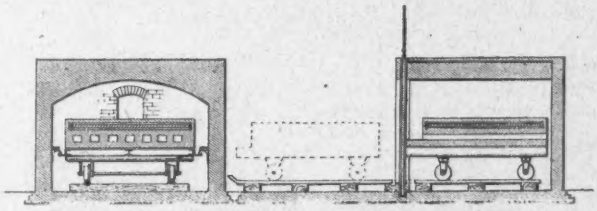


Fig. 1.—Cementation Furnaces, with Movable Hearth.

covered with an even layer of finely ground charcoal. In most cases two plates are placed together on the hearth, the charcoal being sandwiched between the two, by this method two surfaces are treated at one operation. The plates are drawn into the furnace on the hearth and subjected to a high temperature, continued long enough for the charcoal to penetrate the plate to a depth of ·79 in. When the plate has attained its correct temperature it is removed from the furnace and hardened in a large tank of cotton-seed oil.

From the oil dip the plate is sent to the scaling shop where the carbon scale is chipped off by pneumatic hammers.

The next process is bending. The plate is reheated to a dull red, and afterwards placed under the hydraulic bending press. Here the correct curvature is given, the plate being shaped to wooden templates.

After bending, the plate is sent to the machine shops. If required the surface is planed, the rough edges ripped off, either under a ripping or planing machine, and drilling, slotting, tapping and other machining carried out.

It is necessary that the edges of the plates should have a correct angle and be free from tool marks which occur in machining; to remove these and other irregularities the edges are ground with a grinding machine.

After grinding, the plate is sent for final hardening. Here it is built up on the movable hearth of the furnace with bricks and sand, so that the surface of the plate, which has previously been cemented, is directly exposed to the heat. At the correct temperature the plate is taken from the furnace to the sprinkler, where numerous fine jets of water are played on it. This imparts great hardness to the cemented surface, so that it cannot be touched with a cutting tool. As the plate, apart from its cemented surface, is of relatively soft steel, it can be machined fairly easy as long

as it is not tempered. Therefore, all drilling for bolt holes, tapping and slotting, &c., has to be carried out before the final hardening. If, however, after the plate has been hardened and a hole has been wrongly drilled, or another hole is required, the part where alteration is wanted is annealed with electricity, so that the machine tool will operate.

During the final hardening, surface cracks occasionally appear, also pieces may fly off the surface, or a wrong hole has to be filled up. These fractures and errors are made good with the electric arc, small pieces of steel being melted under the arc and welded into the fractures. The welded surface after being treated with the arc is, of course, very hard, and in order to make it clean and even it is worked up with the grinding machine.

Finally, the plate is sent to the erecting shop where it is assembled, and adjustments made before it is sent to the shipyard.

A very great difference in the method of handling the material is found in every works, also the plant varies considerably. One noticeable feature is that nearly all manufacturers have adopted continuous-current generation and distribution with continuous-current motors for machine driving.

Electricity has not yet been introduced into English works for operating the rolling mill. In three different works with which I am acquainted, the power required to turn the rolls, when rolling a plate, is 3,700, 8,000 and 10,000 H.P. in each case. The engines are of the reversible triple-expansion type. The particulars of one mill are interesting, and some idea of its size will be gathered from the data given. The rolls are of forged steel, and have a length of over 13 ft. and a diameter of 4 ft. A small engine fixed at the top of each housing is used for increasing or reducing the distance between the rolls, driven through bevel gear. In course of rolling, the plate is carried through the rolls by another set of driven rollers fixed just above the floor level and operated from the main engine. Hydraulic rams are fixed between the ground rolls, so that the plate can be raised and the crane dogs inserted under the plate for lifting away.

Figures are not yet available to show that electricity is superior to steam for large units such as the rolling mill. Where so much steam power is required and only on intermittent service, this part of the business is a costly item.

Hydraulic power is extensively used not only for the presses but for other auxiliary plant. Works managers still hold that the same precision of movement in cranes and various other operations is not attainable by electrical means as by hydraulic. In one works that I know, the traverse motions of the cranes serving the presses are motor-driven, but the hoisting and lowering are hydraulic. In connection with the oil dipping of the plates, one or two firms have a combined electric and hydraulic crane, electricity being used for the traverse motions and a combination of hydraulic power and electricity for hoisting and lowering. When a plate is being dipped it is said that a quick lowering movement is necessary to keep the oil from firing due to the heated plate, and by opening the hydraulic valve, the plate makes a rapid plunge into the oil, a brake being used to check its progress at the required time. It will be quite understood that such an elaborate appliance is costly and complicated. Another firm uses the ordinary electric crane and overcomes the firing by an extensive circulation of the oil. In any case the temperature of the oil has to be kept down, motor-driven pumps of the centrifugal type being usually adopted.

The hydraulic pumps for the bending and shaping presses may require 1,000 H.P. to drive them, and in most cases steam power predominates. The presses are capable of exerting a total pressure of 10,000 tons or more. For the smaller sizes of hydraulic pumps, especially those with accumulators, motors are used for driving the pumps.

It is quite clear that a large crane service is necessary, and, at the same time, the lifting capacities are on the large side. In nearly all cases auxiliary hoisting motions are adopted, bringing in the use of four motors, and in several instances a slow and quick gear is used in connection with the main hoisting motion. In the press shop of one firm a crane has been recently installed with a lifting capacity of 80 tons. The main hoist in slow gear with 80 tons is 10 ft. per minute; quick gear, 40 tons, at 20 ft. per minute; and auxiliary hoisting motion, lifting 30 tons, at 15 ft. per minute.

The largest cranes used are over the casting pits, and vary in size from 125 to 150 tons. I am acquainted with a 125-ton crane manufactured by Messrs. Vaughan & Son, of West Gorton, the cross and long traverse of which are 50 ft. and 100 ft. per minute respectively. At the request of the makers of this crane, I have purposely omitted the speeds of the main and auxiliary hoisting motions, so as not to convey a misleading impression of the manufacturers' capabilities. There are cranes in the machine shops, press shops, rolling mill, cementation department, grinding shop, final hardening, Siemens, scaling shop, erecting shops, and welding department, &c., and all have lifting capacities of not less than 30 tons, and some reach as high as 80 tons.

In all cases spur gearing is used, and is preferred to worm gearing for hard and continuous work. Where slow, accurate movements are requisite, or where a large speed reduction has to be obtained within a limited compass, the worm drive has undoubted advantages. A very high efficiency is obtained with worm gearing and ball bearing end thrust, so much so that a brake is necessary to check the load when lowering.

The solenoid release brake is popular, chiefly because it has been found less sensitive to the disturbing effects of slight wear on the brake blocks. The solenoid is usually wired in series with the hoisting motor.

The liquid reversing controller continues to make progress, and for simplicity, wide speed variation, and hard work, the wire-resistance controller has difficulty in competing with it.

In connection with the movable hearths of the furnaces, capstans are used for drawing the hearth in and out. I have personally taken observations of the power required to move these hearths, and where one has been left in a furnace and allowed to go cold a 50-H.P. motor would not draw it out, owing to the wheels binding on the rails they run on. Reversing switches are not necessary with the capstans, the forward and reverse motion being obtained with a wire rope fixed at the front and back end of the carriage which is drawn tight round the capstan by the operator whilst running.

Whilst on the question of furnaces, motors are in use for lifting the heavy doors; special precautions have to be used in choosing a suitable motor on account of the high temperature, as its position is usually over the top of the furnace. For operating the motor a reversing switch is necessary. The wiring and lubrication of the motor has to be carefully considered.

The sprinklers used for the final hardening are interesting. These are specially designed to suit the individual requirements, and electricity could be adopted for the pumps with economy, especially if situated at a distance from the main steam supply. Steam, however, is used in most cases. For drawing the top jets of the sprinkler over the plate a series-wound motor is used, with a reversing switch in circuit, the current being picked up by collectors in contact with four bare copper wires.

The arrangement of the pneumatic hammers permits of the tool chipping the surface of the plate with ease and rapidity. A two-stage compressor driven by a motor provides the air which is distributed to various points, and flexible tubes connected to these points convey the energy to the hammers.

Both dry and plastic ganister and luting are extensively used for the Siemens furnaces, ingot moulds and ladles. The mill used for grinding the above is of a familiar type, similar to the ordinary mortar mill with a top or under-driven shaft, the pan revolving the crushers.

An ore crusher of the usual type, driven by a motor, is used in the Siemens department.

Large nuts and bolts are required for holding the plates in position on the ship's side. Automatic machines are used for drilling, tapping and polishing the nuts, and screwing and turning the bolts.

The machine shops are, for the most part, equipped for individual driving. A good arrangement is that where the machines are fixed down each side of the shop, and the space between used for accommodating the plates, which also provides an easy passage for the movements of the crane.

The planing machines are of an unusually massive and powerful character. Various types are in operation; two with which the writer is acquainted are here described. The first is designed with short vertical housings and a pit to take the plate. Each housing has its own bed, and is driven along it with a screw. The cross-beam spanning the pit has lifting and lowering motions worked from the housing. The saddles on the cross beam have feeds, independent in direction and amount, worked with mechanism mounted on the end of the cross-beam or worked by an independent motor. The machines are designed to take heavy cuts and have a capacity between housing of 13 ft. and vertically from the bottom of the pit, of 10 ft. The beds have a length of 27 ft. and a working travel of 25 ft. The speed of travel for the forward and return motion of the tools is the same. The screws are driven with open and crossed belt, through a train of spur gearing. The second machine, an American make, was different from the first, inasmuch as the cutting tools were fixed, the plate being moved against them on the driven table. The feeds for the tools are independent in direction and amount, each having a crank disk for regulating the amount of feed. The bed is in two pieces, and has a vertical depth of over 4 ft. The ways on the table are flat, 16 in. wide and 7 ft. from centre to centre. One bearing only is guided. The table is provided with a steel rack of 3 in. pitch and 18 in. on the face operated by a bronze spiral pinion on a diagonal shaft 9 in. in diameter. The housings are of box construction 30 in. on the face, 19½ ft. high and have a capacity between them of 12 ft., and a height of 10 ft. The length of the table is 27 ft., and it has a working length of 25 ft., and a width of 10 ft. The power required to drive one of these planing machines varies according to the number of tools in use. A 40-H.P. motor will have more than its full work when surface planing is carried out with 12 tools. For ripping the rough edges off a plate with two tools, the load is about 15 H.P., to run the machine light 7½ H.P. is required, and on reversing 75 H.P. Occasionally the cutting speed is increased, so that a variable-speed shunt-wound motor is used.

Various devices have been invented to eliminate the large current taken on reversal of the planing machine. The one in which the direction of rotation of the motor armature is used for reversing the machine is worth consideration. The system has one fault, and that is, the apparatus is complicated.

The radial drilling machines are constructed for boring holes and cutting threads in plates in their bent state. The boring spindle can be driven at ten different speeds by the use of a five-step cone pulley and various wheel gears. The arm which moves up and down can be turned through an angle of 100°. The slide can be adjusted radially, both by hand and power. The spindle is balanced and is put into gear automatically, or by hand by means of worm gearing. Its own motion can be varied by a four-step cone pulley. There is a special device for promptly releasing the nut when cutting threads up to 6 in. diameter, for which purpose a screwed tool is employed. The diameter of the boring spindle is 6¼ in., its vertical travel is 27½ in., the maximum radial range is 12 ft. 4 in., the maximum elevation of boring head above floor 10½ ft., and vertical travel of arm 6½ ft. The total weight of the machine, without bedplate, is 38 tons. A shunt-wound motor of 15 H.P. is required for driving it.

Slotting machines with a stroke of 64 in., small drilling machines, multiple radial arm drilling machines, lathes, trepanning machines, ripping machines and edge planers for taking curved plates are to be found in the machine shops, all motor-driven. In other shops slow-speed circular saws with renewable teeth will be found for ripping off the plate edges. Fig. 2 shows a simple sketch of one of the grinding machines; it will be seen that the armature shaft is extended, at the end of which is fixed the frame holding the stones. The motor frame and armature can be tilted to any required angle from the horizontal in one direction (fig. 3), and owing to this being necessary, grease-cup lubrication has to be adopted in place of the usual ring lubrication. The grinding feed can be put on the edge of the plate either by hand or an independent 3-H.P. motor. The grinding motor, which is 40 H.P. and compound wound, is mounted on a pedestal, which is in turn placed on a sliding bed and driven by a screw round which a white-metal nut is cast and attached to the underside of the pedestal. A 5-H.P. shunt-wound motor, with crossed and open belts for forward and reverse motion, drives the screw, thus moving the whole machine on the bed in a longitudinal direction parallel with the plate.

Portable motors are used in the erecting ship, fitted with flexible shafts. The motor is protected in an iron case, on which is mounted the starting switch, the whole being fitted on wheels. Connection is made, by flexible twin wires, insulated with rubber and with an outer braiding of wire, to plugs and sockets fixed at different points in the shop.

The welding plant is independent of the power plant. The workman is provided with a holder carrying a carbon, about 1 in. diameter, to which is attached a heavy piece of flexible cable. The operation is viewed through a deeply-tinted glass mask attached to the workman's head. The arc is struck by touching the plate with the carbon and then drawing it quickly apart for a short distance. The pressure between the carbon and the plate is 70 volts; the minimum current is about 300 amperes, and may reach 500 amperes. A steadying resistance with multiple contacts in series with the arc is found indispensable. The variations without the resistance are too great to allow of proper control by the

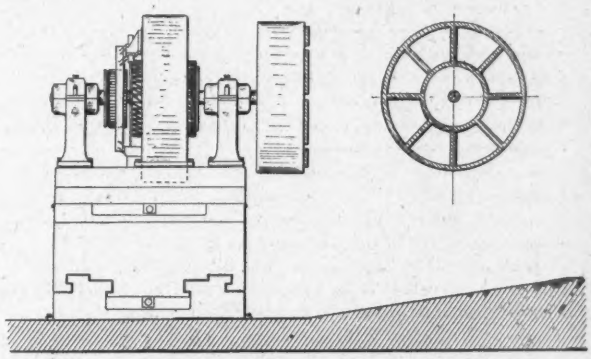


FIG. 2.—ELECTRICALLY-DRIVEN GRINDING MACHINE.

workman, The carbon is connected to the negative pole and the plate to the positive pole of the generator.

The annealing plant consists of a continuous-current motor or any other prime mover driving an alternating-current generator, the capacity being 35 KW. The alternating-current pressure is 300 volts. The alternating-current is lead into a step-down transformer with a single turn as the secondary on each limb, the ends of which are attached to two heavy copper contact blocks fastened to the iron core of

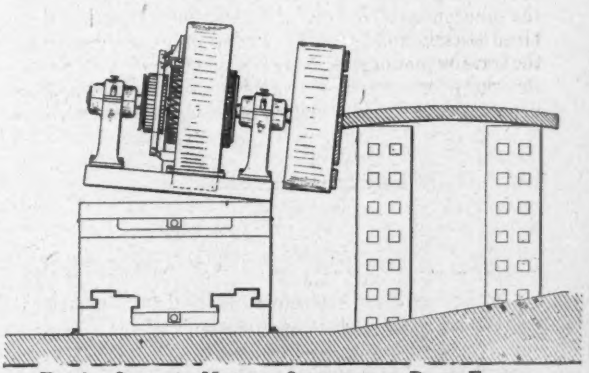


FIG. 3.—GRINDING MACHINE OPERATING ON PLATE EDGE.

the transformer. The blocks are so constructed that cold water is constantly circulating through them. The output at the transformer secondary is 15,000 amperes at 2 volts. This current is sent through the small patch of armour plate that requires softening, by way of the massive copper contacts, until it reaches a red heat. By slowly reducing the current at the generator, the patch is gradually cooled, after which the metal will be found to be fairly soft, and can be operated by the machine tool.

On account of numerous high temperature underground

gas and other flues and machine foundations, also hot ingots and plates placed on the floors, feeders and distributors cannot safely be laid in the ground. Insulators fixed to the rafters in the roof will be found the most suitable place for mounting the cables. Cable of 1 in. sectional area can be conveniently drawn into the roof, and where several large cables go through one shop it will be found advisable to erect special cable ways. The close proximity of cables to furnace tops, steam pipes and all places where the temperatures are very high, should be avoided. In the machine shops it may not be necessary to keep to hard and fast rules, but whatever system is adopted, even in these places, the movements of the cranes have to be considered. To run separate feeders according to requirements to the entrance of each department and terminate in a multiple way ironclad distribution board is the best arrangement. From the distribution board the distributors can be attached to the walls down each side of the shop, the motor circuits being tapped at various points along the distributors through small split ironclad disconnecting boxes secured to the wall.

All motors, both for cranes and machine driving, should be totally enclosed if fixed in any place other than the machine shops. It is as well to extend this practice to motors in the capstan pits.

Motor switchgear should be as simple as possible, and all live parts totally enclosed in every instance. This not only prevents accidental shocks, but all contacts will be kept in a better state of preservation, and workmen will be less liable to tamper with the apparatus by replacing their own fuses, screwing up loose contacts, &c.

Arc and incandescent lighting is in great demand, the former being adopted for the yard and shop lighting, and the latter for hand lamps on the various machines for close inspection of the cutting tools, and also in the offices.

In many works the pressure for both lighting and power does not exceed 250 volts, but there is no reason why 400 or 500 volts cannot be adopted, a motor-generator being used to reduce the pressure for the lamps.

A close inspection of the working conditions of every piece of apparatus and machinery shows the variable character of the load on the generating plant. Cranes, capstans, grinders, &c., and the reversing of planing and slotting machines are responsible for this variation.

There is nothing out of the ordinary in the generating plant; 3,000 KW., and even more, is a common plant capacity in works of this kind. Both shunt and compound-wound generators are to be found in operation with the usual switch and regulating gear and feeder panels.

In one works with which I was acquainted there were planing machines absorbing 480 H.P.; ripping machines, 120 H.P.; capstans, 240 H.P.; grinding machines, 384 H.P.; slotting machines, 42 H.P.; circular cold saws, 20 H.P.; drilling machines, 304 H.P.; grinding mills, 32 H.P.; edge planers, 40 H.P.; hydraulic pumps, 600 H.P., and sundry small motors amounting to 200 H.P. The lighting consisted of 1,150 arc lamps and 3,000 incandescent lamps.

RATES AND SYSTEMS OF CHARGING.

By JACQUES.

Now that so much is being done in the way of endeavouring to bring new consumers to the mains, it would seem an opportune time to reopen the old, old question of rates of charge, as this is, after all, the most important point in all dealings between supplier and consumer, and no authority where rates are unsuitable, from any point of view, can hope to obtain adequate return on the trouble and money expended on its canvassing campaign.

On the other hand, an "attractive" rate will often do all the advertising necessary for an undertaking.

A glance through the tables of supply authorities in the country reveals an appalling diversity in the manner of charging for electricity, and a closer investigation of the subject will show that even individual undertakings have, in many cases, an extraordinary assortment of charges and rates for different uses and users.

It is a matter of fact that, in one particular district, supposing one to be a large shopkeeper with "premises over," in order to obtain the full benefit of the rates of supply offered by the undertaking one must contract under as many as six different rates—viz., the lighting rate (a sliding scale) for the living premises, a contract rate of so much per ampere per annum for the inside arc lighting, another special rate for the outside arcs, the lighting rate for window illumination during business hours, a special rate for ditto after closing time, a basement rate for below-ground rooms, the same rate for outside "sign" illumination, power rate for heating, &c., and the beauty of it all is that each of these rates necessitates a separate circuit (and possibly some of them divided on to "both sides" for balancing purposes) and among them requiring five meters, one time switch, and one overload cut-out, for all of which one has the privilege of paying rent!

There is one saving point in the above authority's favour, however; for, apparently realising the absurdity of the situation, it refrains from publishing on its schedules more than the sliding scale and the power rate, leaving one to discover the rest (after probably wiring the premises on one circuit), and then the tale of rates is incomplete, as there is the Public Lighting Rate!

Apart from these varying rates in one area, there are the numerous systems in force throughout the country, the maximum demand, sliding scale (with or without discounts), flat rates for different uses, double tariffs (time factor considered), Hopkinson charges, &c.

The writer is aware that this is a very old horse to flog, but the importance of the question from its influence on the commercial development of an undertaking, apart from its theoretical interest, is sufficient excuse to warrant a renewed discussion of the subject.

Starting *da capo*, the main objects of a perfectly ideal rate are twofold, first to secure an adequate profit to the undertaking, secondly, to assist in discriminating between the various classes of consumer, so as to automatically make the more undesirable user pay more per unit than the desirable or long-hour consumer.

It should go further than this, however, and tend to flatten out the load curve by encouraging use outside peak hours and also *dis*couraging use during these hours, which, however revolutionary at first sight, is sound practice within limits.

The aims of every authority are summed up in this statement of the objects of the perfect rate, and the multifarious rates and systems in use are all efforts in the same direction—many of them misdirected, doubtless, and all of them wrong where they tend to complication, or where they impose disabilities on the consumer, thus retarding the growth of the undertaking, and also wrong in principle where they differentiate between lighting and power uses, *as such*, without reference to time of load.

It seems to be almost an article of faith with many station authorities that lighting must invariably be paid for at a higher rate than power, irrespective of when it is used, and some seem to regard almost as blasphemous heresy any suggestion of a combined rate for light and power.

What on earth does it matter how the current is used, so long as it is used?

The perfect system of charging should also allow of the simplest possible installation on the consumers' premises and require only the simplest of instruments to check or control the circuit, as the present meter system is most expensive to the station, even if meter rates are charged, and when charged they are always objected to, and rightly, by the consumer.

It is more than likely that eventually we shall be content with an "Electricity Rate" *à la* water rate, and dispense with meters altogether, and so save a vast amount of trouble and expense.

But till that happy day dawns, we have still to charge by the best means available, so it may be well to state as a definition what an ideal rate is, and in the writer's opinion that is:—

1. One that shall be *one* rate for all purposes.
2. One that shall tend towards a flat curve.

3. One that shall be discriminating in an automatic manner.

4. One that shall require the simplest form of controlling instrument.

5. One that shall require but one circuit per consumer (except for balance).

6. One that is perfectly simple to explain.

Comparing the various systems in use with this ideal, we find that :—

(*a*) The maximum demand system fails under heads 1, 2, 4, 5, 6, and partially fulfils No. 3.

(*b*) The sliding scale or scales fail under Nos. 1, 2, 3, 5, and partially fulfils Nos. 4 and 6.

(*c*) Flat rates for different uses fail under Nos. 1, 3, 5, and partially fulfil Nos. 2, 4, 6.

(*d*) Double tariff or two-rate system fails under Nos. 1 and 4, and succeeds fairly well as to Nos. 2, 3, 5, 6.

(*e*) Hopkinson system fails under 1, 2, 3, 6.

(*f*) A "flat rate per ampere per annum" rate fulfils more or less all the conditions.

To amplify these summaries a little :—

(*a*) The maximum demand system, from which so much was at one time hoped for, has proved to have no effect on the curve whatever, as may be seen by inspecting the typical curves given in, say, "the White Book" for station working with the system. It necessitates separate rates for light and power, with separate circuits for each, and two instruments per circuit, and consequently an expensive meter department, and—a serious defect, the system is practically never understood by the consumer.

(*b*) The sliding scale system has as its chief fault the fact that rebates are allowed to the large consumer irrespective of the length of time over which his load is spread, and it also requires dual circuits for light and power uses. Simple meters only are required however.

(*c*) Multifarious flat rates are usually the result of a struggle to keep prices up as much as possible, each rate being adopted as it is found that users will not pay more for that particular service. While the system recognises the diversity factor to an absurb degree, it inflicts the burden of numerous circuits and meters on the consumer, and is only arbitrary in its discriminating effect. The number of meters necessary is enormously increased, and with it the cost of the meter department.

(*d*) The two-rate system is excellent in that it does away altogether with separate circuits, and it favours the long-hour consumer ; it encourages "valley" loads, and tends to lop off the top of the peak. The writer knows of a town in Wales where consumers started using gas over the peak or high-rate hours, when this system was first tried there. Its chief drawback is the expensive meter, or time switch and one or two meters necessary per consumer, otherwise it is excellent in both theory and practice.

(*e*) The Hopkinson system is more usually applied to power than lighting. It is an equitable system though it has a discouraging effect on installations, as "it puts a premium on the use of electric service in other than the most necessary manner," to quote an American writer.

(*f*) The "flat rate per ampere per annum" system is one which is being tentatively tried in one or two districts at present, and seems to be fairly satisfactory.

This rate is based on what the station could afford to supply at on a 24 hours' load, and is usually payable in advance. For instance, if a 200-volt station estimates ½d. a unit as a fair price for a 24-hour load, its rate would be 73s. per ampere per annum, or, roughly, 12s. per 8-C.P. per annum *with unlimited use*.

The load paid for is what the consumer estimates as his minimum maximum, to use an Irish expression, and the circuit is controlled by an automatic cut-out, which prevents more than the amount contracted for being used, by "jigging" or "dimming" the whole load till it is reduced to contract amount.

By this system of charging the consumer always knows exactly the amount of his account, is encouraged to make prolonged use of his installation, and so installs apparatus which he can use at times when his circuit is not wanted for lighting purposes. Overloading is impossible and sudden individual peaks entirely wiped out as the cut-out sees to them. The controlling device is much cheaper than a meter to buy and maintain, and so part of a great expense to the station, the meter department, is done away with. No penalty is attached to installing a large number of current-consuming devices in the way of a premium per KW. *installed*, as the amount payable depends entirely on what is to be *used* regularly.

In a house of, say, 50 lights, the probable number contracted for would be, say, 30, and the consumer will see to installing something in the way of kettles or radiators to use when his lights are not wanted, so *he* is satisfied by having unlimited use of his contract load, and the station gets something more like a gently undulating range of hills for its curve instead of a contour of the Andes.

It is an absolutely simple rate to explain, and has apparently proved successful where tried, and should prove of great advertising value, but even with this rate there is a fly in the ointment in certain cases, *e.g.*, some loads, as lifts, when they are very few in number, are vile and most unsatisfactory in nature, but, given plenty of them, the diversity factor makes them a very desirable *total* load, and so it becomes inadvisable to penalise them, as one would, heavily, under this rate.

The conclusion seems to be that *one* rate is almost impossible to realise, but that a general "flat ampere per annum contract rate" coupled with a few cases of either two-rate or low power flat rate charging will come as near the ideal as we are likely to get till the service is rated in a similar manner to water.

FOUR-WIRE DISTRIBUTION.

By HAROLD H. JOWERS.

The author hopes to receive the opinion of various readers on this method of distribution, and as the direct-current three-wire system of distribution is in the majority, it should be of interest to station engineers.

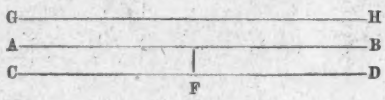
The system is to distribute on the three-wire system, but the distributors consist of two concentric cables laid side by side ; the outers to be the cores, and the neutrals to be the outer ring of wire in each cable. The great advantage claimed, is that of great safety for maintaining the supply, for it will readily be seen that it is practically impossible to get an earth on either outer.

The cost of this system is the cost of two concentric cables against three single cables, or triple-concentric, but as the system is similar to the three single-cable system of distribution, it is only fair to compare it with this. Take, for example, a three single-wire system with distributors of any section armoured cables, laid direct in the ground ; then with two concentric mains, as the neutral is the outer wire in the cable, it would not be necessary to have these cables armoured, and they could be lead covered with just a preservative of jute, braid, or yarn. This would bring the costs about equal, that is, with the mains laid direct in the ground. If they were laid on the solid system the three single cables would come out a little cheaper, but the additional cost of the third duct and bitumen would tend to bring them more equal.

With the two-concentric cable system, one would have a good waterproof lead covering to the mains with very little danger of getting a short-circuit to the lead, for in case either positive or negative did tend to break down, it would cause a short-circuit to the neutral, and blow the section fuse ; also the fault would be confined to the one spot only, and this would obviate all danger of a large current flowing along the lead and damaging the mains at the badly bonded joint boxes, which generally results in a service or two being burnt out. Even if the three-wire system had the neutral insulated with the exception of the earthed point at the station, and a controlling resistance in circuit with that point, the current would still tend to form a danger, however small it might be cut down to, and in time this small leakage would have a bad corrosive action on the sheathing. Again, take this fault to occur on a section that had a large power consumer

on (this would naturally be across the outers), the neutral could be quickly disconnected, and the current put on again without the danger of blowing lamps, also the consumers on the one side would still have the supply.

The fault could be rapidly located by means of the following simple test :—



Let A B represent the faulty neutral ; C D represent the faulty outer ; G H* represent the loop wire ; F represent the position of fault. Short-circuit B H.

At A connect a bank of lamps to live neutral ; take volts across A G, this is the fall of potential from F to A (V_1) ; remove short-circuit to G A, connect bank of lamps from B to live neutral ; take volts across H B, this is the fall of potential from F to B (V_2).

Then if L = the length from A to B, distance of fault from

$$\text{A to F} = \frac{L}{V_1 + V_2} \times V_1.$$

With this system it would also be possible to obtain the exact current in the neutral on any section, for it would be the same as in the outer for that section, and there would not be the danger of over-running the neutral for short lengths, which is no doubt done in a great many cases.

Also, the neutrals could be fused in the section boxes without the danger of having lamps blown, and this would enable one to quickly locate any section of faulty neutral cable by flashing one outer to earth and blowing the section fuse, for flashing either outer to earth could be done with safety, as the opposite outer would not have the tendency to break down to earth.

The services would consist of concentric cable, and in cases of large consumers who are connected to both sides of the system, there would be two entirely different services, therefore the danger of the neutral failing, and plunging the place into darkness would be reduced to a minimum.

* If this test were made on a main where it was not necessary to have the supply on at the time, the other neutral could take the place of loop wire G H.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

27,157. "Improvements in and relating to electric transformers." L. Maiche. December 9th. (Complete.)

27,177. "Improvements in or relating to insulators." J. C. Barclay. (Date applied for under Patents Act, 1901, July 22nd, 1907, being date of application in United States.) December 9th. (Complete.)

27,189. "Improvements in and relating to telephone apparatus." W. E. Lake. (Aktieselskabet Elektrisk Bureau, Norway.) December 9th. (Complete.)

27,200. "Improvements in apparatus for producing electrical oscillations. K. Birkeland. December 9th. (Complete.)

27,208. "Improvements in electric rock drills." O. R. Mounsey and R. Hacking. December 9th.

27,209. "Improvements in controllers for electric motors and the like." R. Hacking and O. R. Mounsey. December 9th.

27,222. "Improvements in protective devices for electrical systems and apparatus or conductors." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) December 9th.

27,223. "Improvements in electric arc lamp." British Thomson-Houston Co., Ltd., and W. H. Dalton. December 9th.

27,224. "Improvements in electrolytic condensers." British Thomson-Houston Co., Ltd. (General Electric Co., United States). December 9th.

27,225. "Improvements in electrical protective devices of the type known as lightning arresters." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) December 9th.

27,232. "Ampere-hour meter provided with an armature rotating in the field of a permanent magnet." W. Meterling. (Date applied for under Patents Act, 1901, April 19th, 1907, being date of application in Germany.) December 10th. (Complete.)

27,260. "New or improved alternating current machine." R. Goldschmidt. December 10th. (Complete.)

27,278. "Automatic signalling and stopping apparatus for trains on railways furnished or not with block system." L. Maglietta. (Date applied for under Patents Act, 1901, December 17th, 1906, being date of application in Italy.) December 10th. (Complete.)

27,286. "Improved appliance or device for generating and transmitting ound waves." E. V. Gratze. December 10th.

27,289. "Improvements in methods of producing electric oscillations." H. C. Galletti. December 10th.

27,293. "Improvements in electric motor apparatus applicable to machinery of all kinds requiring force." T. J. Howell and E. J. Richardson. December 10th. (Complete.)

27,298. "Contracting device for electrical measuring and indicating instruments." J. Y. Johnson. (Firm of W. C. Heraeus, Germany.) December 10th.

27,303. "Improvements in and relating to primary batteries." K. Heintz. December 10th. (Complete.)

27,346. "Improvement in alternating-current induction motors." T. H. Churton. December 11th.

27,350. "Improvements relating to gas and electric lighting for spinning frames and the like." H. M. Girdwood. December 11th.

27,357. "Improved means for testing the working of internal combustion engines and improving their sparking." C. H. Jones. December 11th.

27,363. "Improvements in trolleys or collectors for electric railways and tramways." H. J. Tompkins. December 11th.

27,375. "Improvements in or relating to tremblers for induction coils." J. Gurney. December 11th. (Complete.)

27,379. "Improvements relating to radio-telephony." The Amalgamated Radio-Telegraph Co., Ltd. (G. Seibt, Germany.) December 11th. (Complete.)

27,385. "Improvements relating to apparatus for the electro-deposition of metals." S. O. Cowper-Coles. December 11th. (Complete.)

27,400. "Electrical and other box couplings." J. J. Rawlings and R. T. Smith. December 11th. (Complete.)

27,401. "Improved electric fuses." J. J. Rawlings and R. T. Smith. December 11th. (Complete.)

27,412. "Improvements in electric arc lamps." H. Bevis and A. E. Angold. December 12th.

27,422. "Device to release tramcar hand brakes, when the magnetic or rheostatic brakes are applied." A. W. Malcolm. December 12th.

27,436. "Automatic electrical transmission of a fire-alarm signal to a fire officially recognised, or other station." T. Tatlock and A. G. Horne. December 12th.

27,447. "Improved safety devices for electric winding plants." Siemens Bros. Dynamo Works, Ltd., and A. S. Clift. December 12th. (Complete.)

27,453. "Improved diaphragm transmitter for telephones and the like." K. Ort, J. Rieger and J. K. Ort. December 12th. (Complete.)

27,457. "Improvements in or applicable to electric bells." C. Herrde. December 12th.

27,486. "Improvements in or connected with electric current transformers." J. W. Davey. December 12th.

27,497. "Improved method for producing metallic incandescent bodies for electric glow lamps." H. W. Purle. December 13th.

27,541. "Improvements in and relating to electric incandescent filament lamps." C. Pauli. December 13th. (Complete.)

27,543. "Improvements in springs particularly applicable to the manufacture of electric incandescence lamps." E. A. Gimingham. December 13th.

27,555. "Improvements in telephone station apparatus applicable for indicating subscribers' call numbers and other purposes." G. A. Powell and J. Taylor. (P. C. Powell, Canada.) December 13th.

27,559. "Improved electrode for use in the purification of water and other liquids." J. M. Murphy. December 13th.

27,560. "Improved apparatus for use in the purification of water and other liquids by electricity." J. M. Murphy. December 13th.

27,562. "Device for controlling the electric current in an apparatus for purifying liquids." J. M. Murphy December 13th.

27,566. "Improvements in the method of and means for controlling the electric circuits of illuminated signs for advertising and similar purposes." J. A. Seager. December 13th.

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27,605. "Improvements in or relating to magneto ignition machines." J. D. Bell. December 14th.

27,608. "Electric thermostat." H. G. Geissinger. (Date applied for under Patents Act, 1901, May 29th, 1907, being date of application in United States.) December 14th. (Complete.)

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Manufacture of Electric Conductors, more Especially Applicable for Use as Incandescing Bodies for Electric Lamps. W. O. Coolidge. 23,334. October 20th. (Date applied for under International Convention, May 9th 1905.)

Manufacture of Electric Conductors, more Especially Applicable for Use as Incandescing Bodies in Electric Lamps. W. C. Arsem. 23,335. October 20th. (Date applied for under International Convention, May 9th, 1906.)

Manufacture of Electric Conductors, more Especially Applicable for Use as Incandescing Bodies in Electric Lamps. W. O. Coolidge. 23,336. October 20th. (Date applied for under International Convention, May 9th, 1906.)

Electric Signalling Apparatus. H. Schorn. 26,219. November 20th. (Date applied for under International Convention, November 20th, 1905.)

Automatic Telephone District System and means for Use in Automatic Telephony. R. W. James. (The Automatic Electric Co., United States.) 26,301. November 20th.

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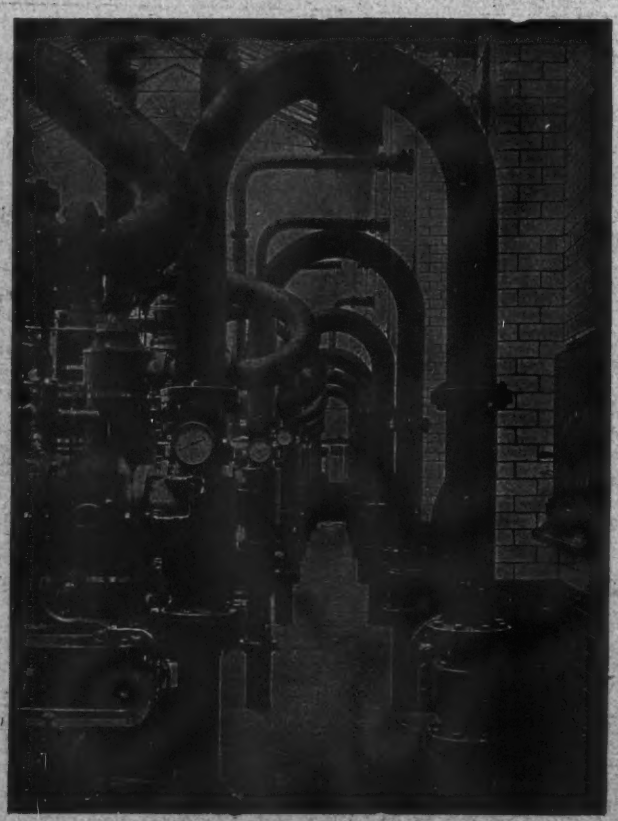

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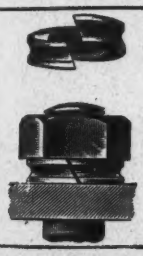

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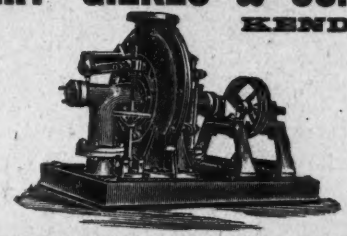

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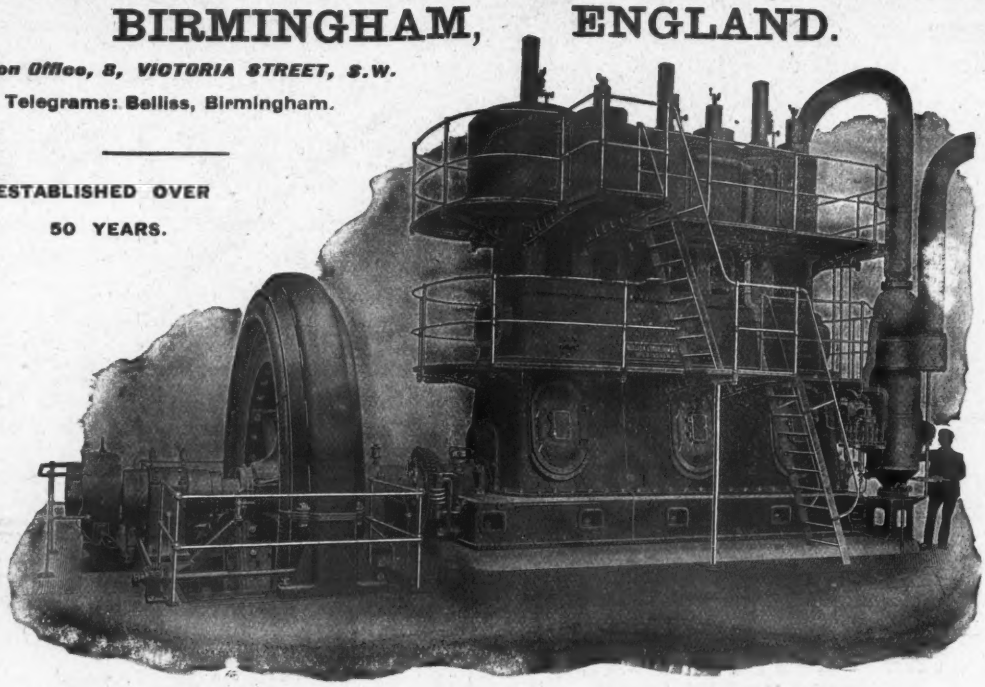

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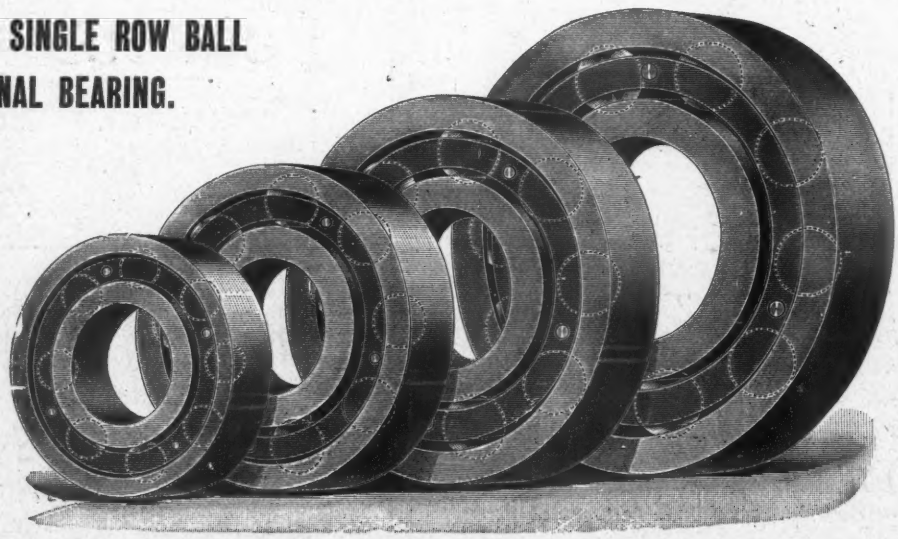

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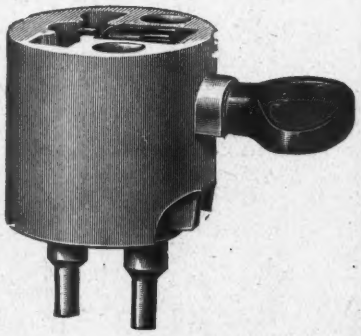

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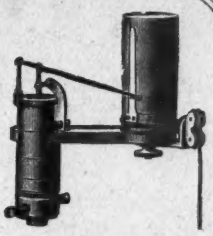

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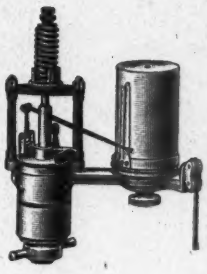

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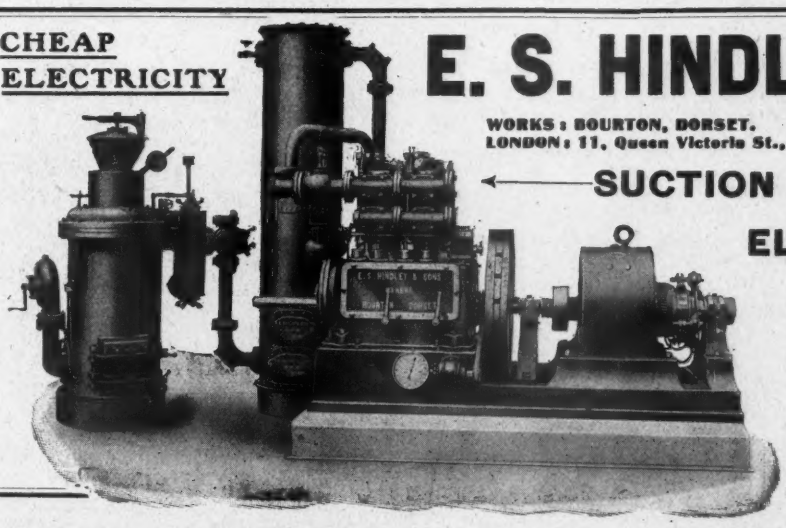

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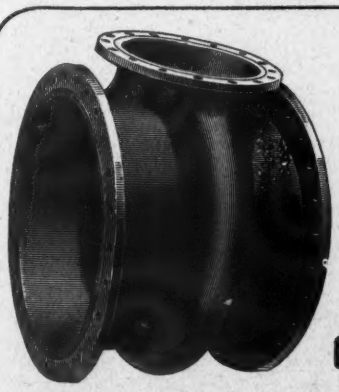

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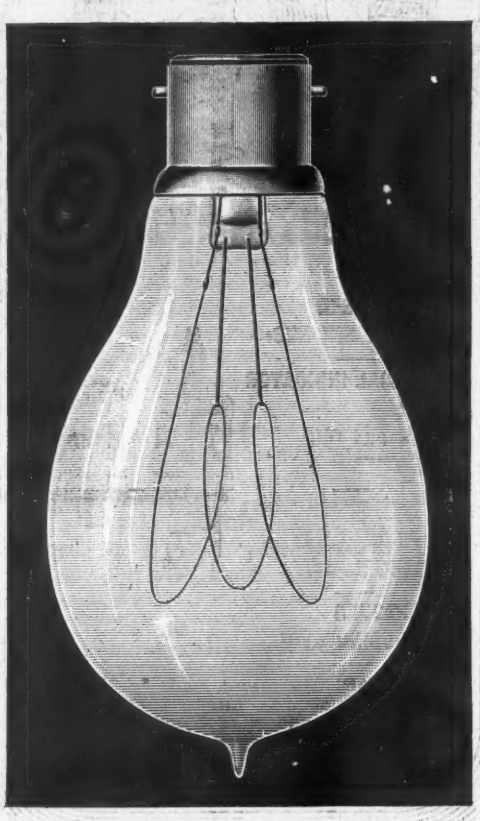

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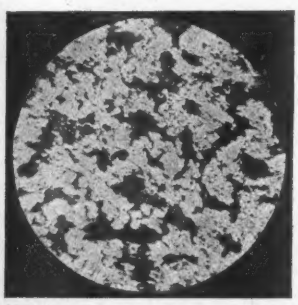

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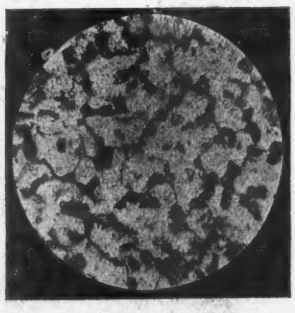

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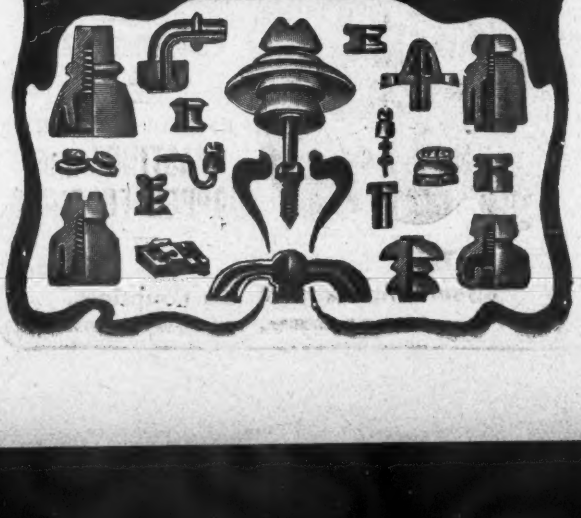

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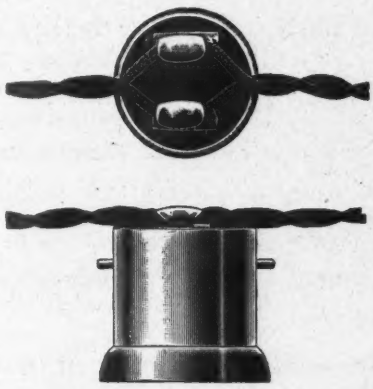

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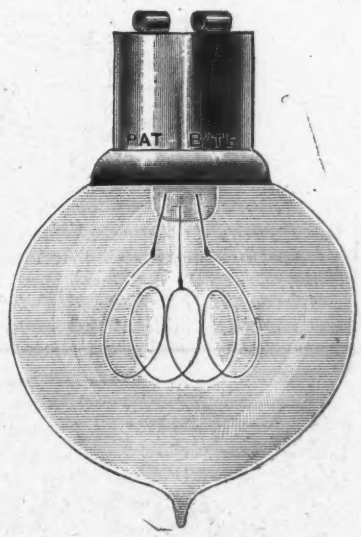

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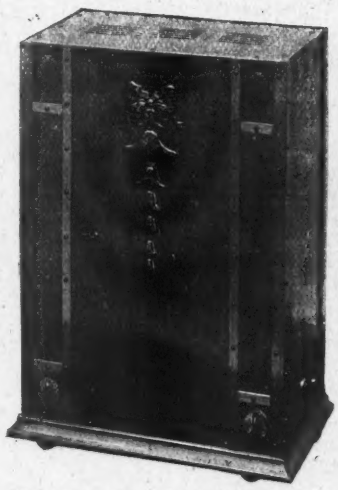

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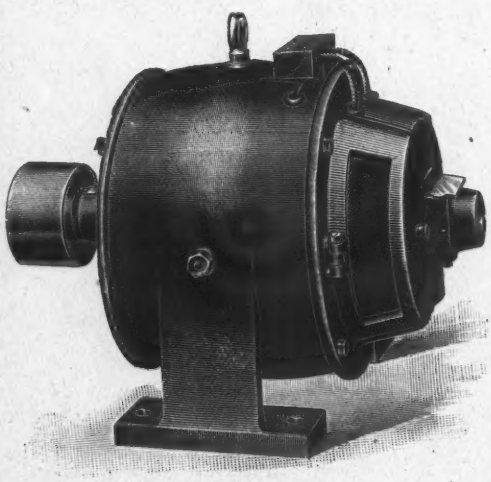

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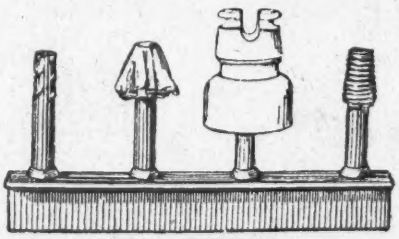

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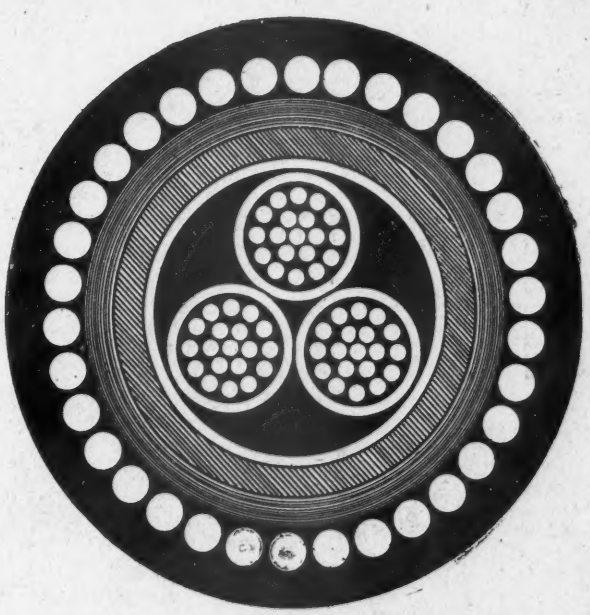

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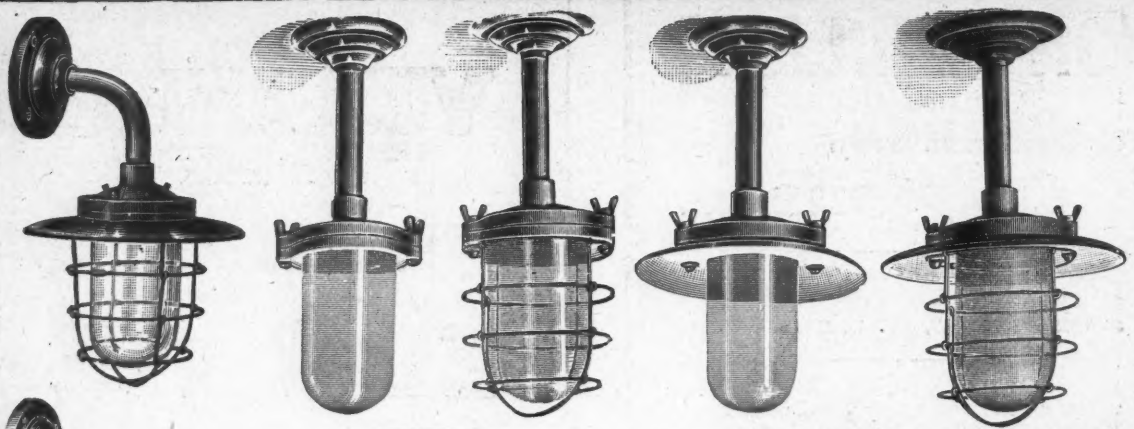

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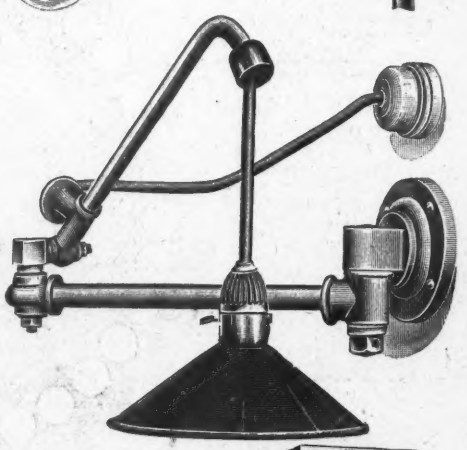

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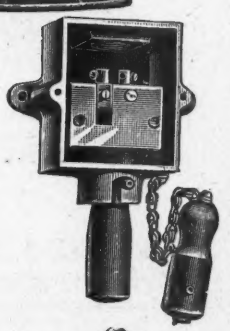

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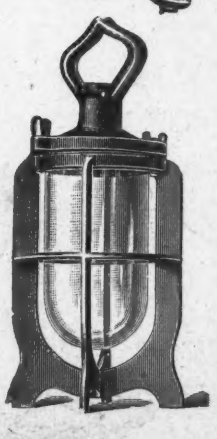

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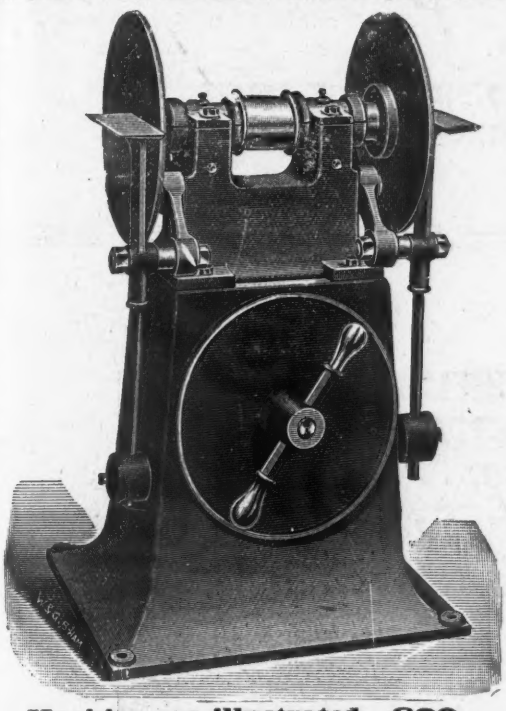

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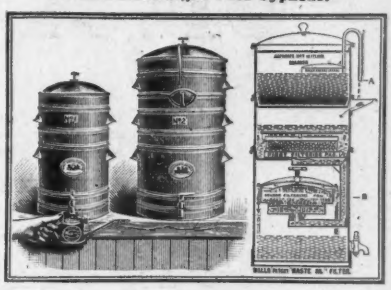

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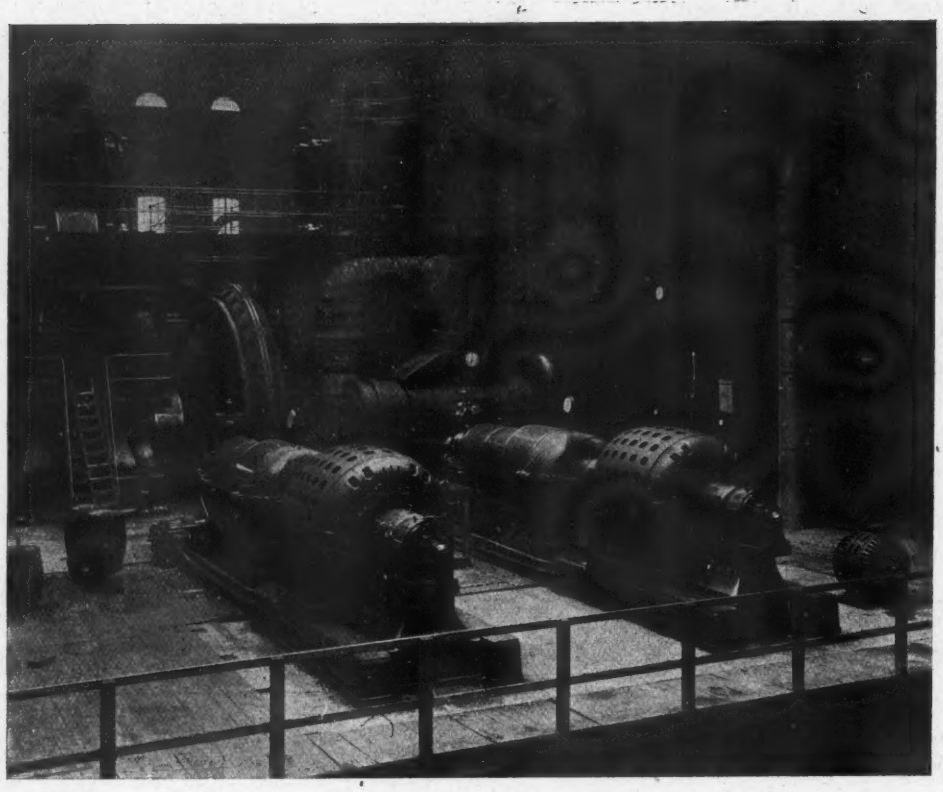

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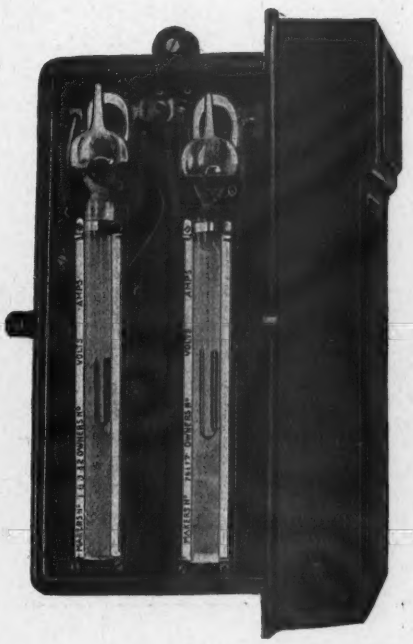

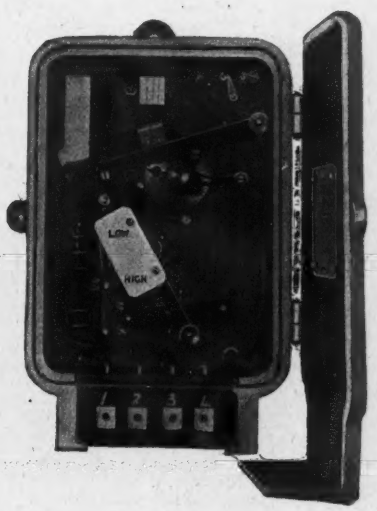

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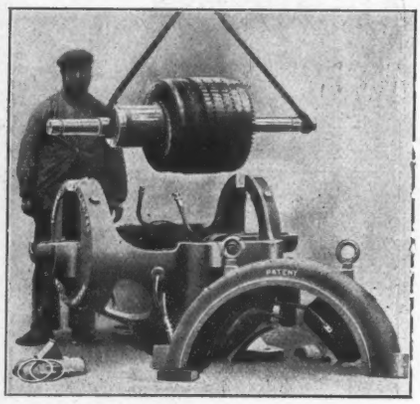

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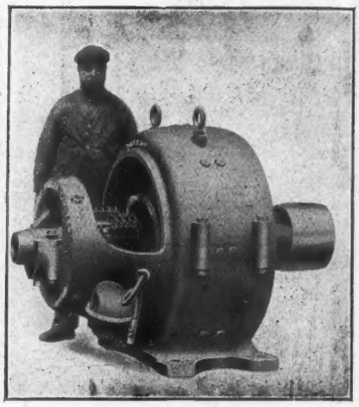

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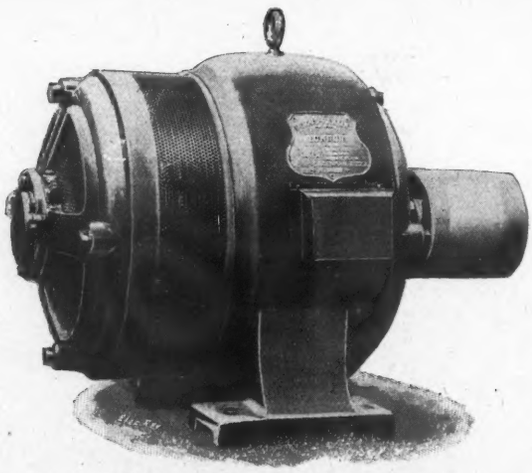

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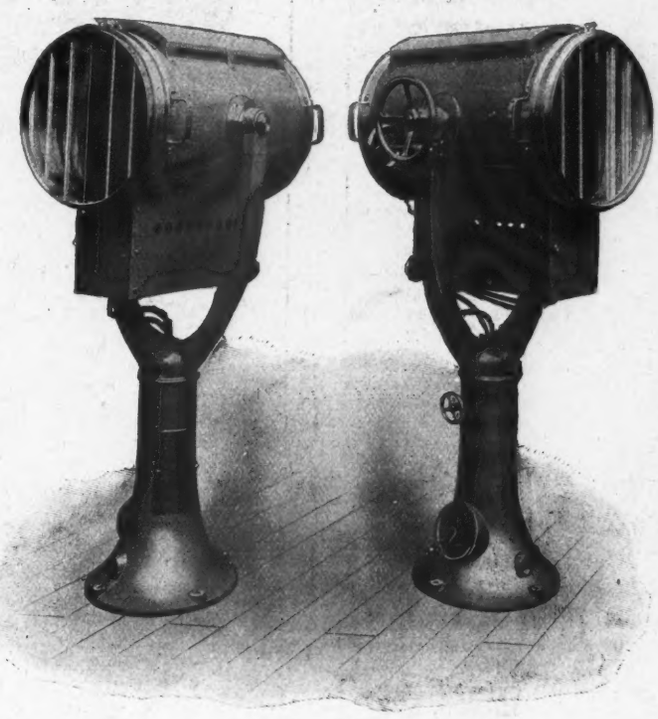

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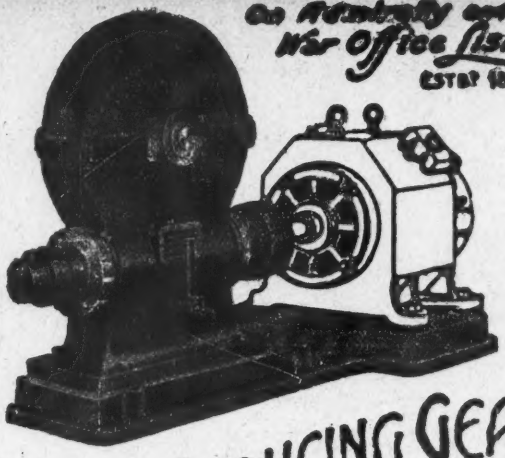

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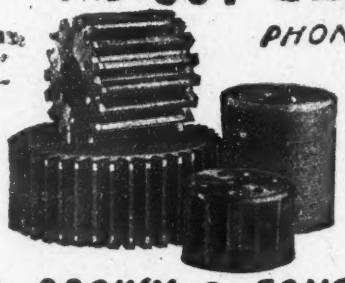

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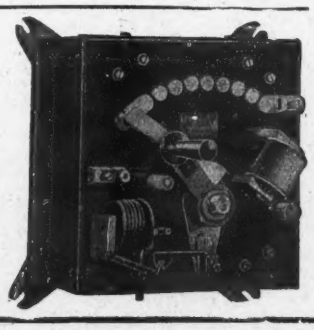

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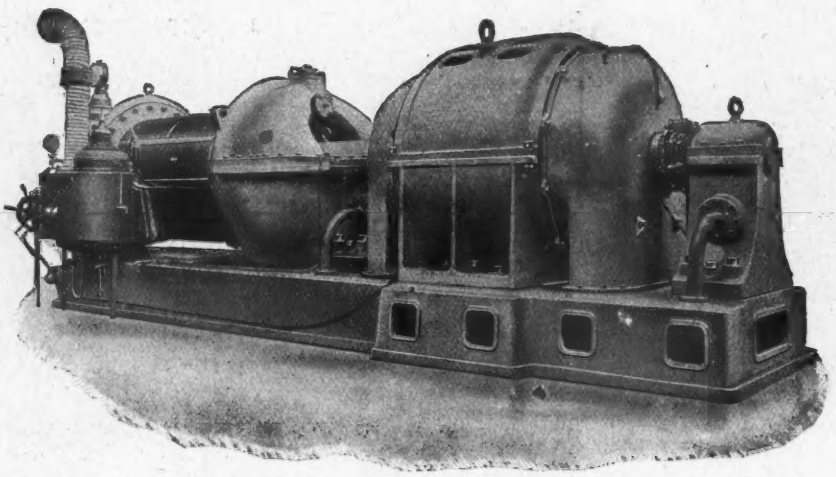

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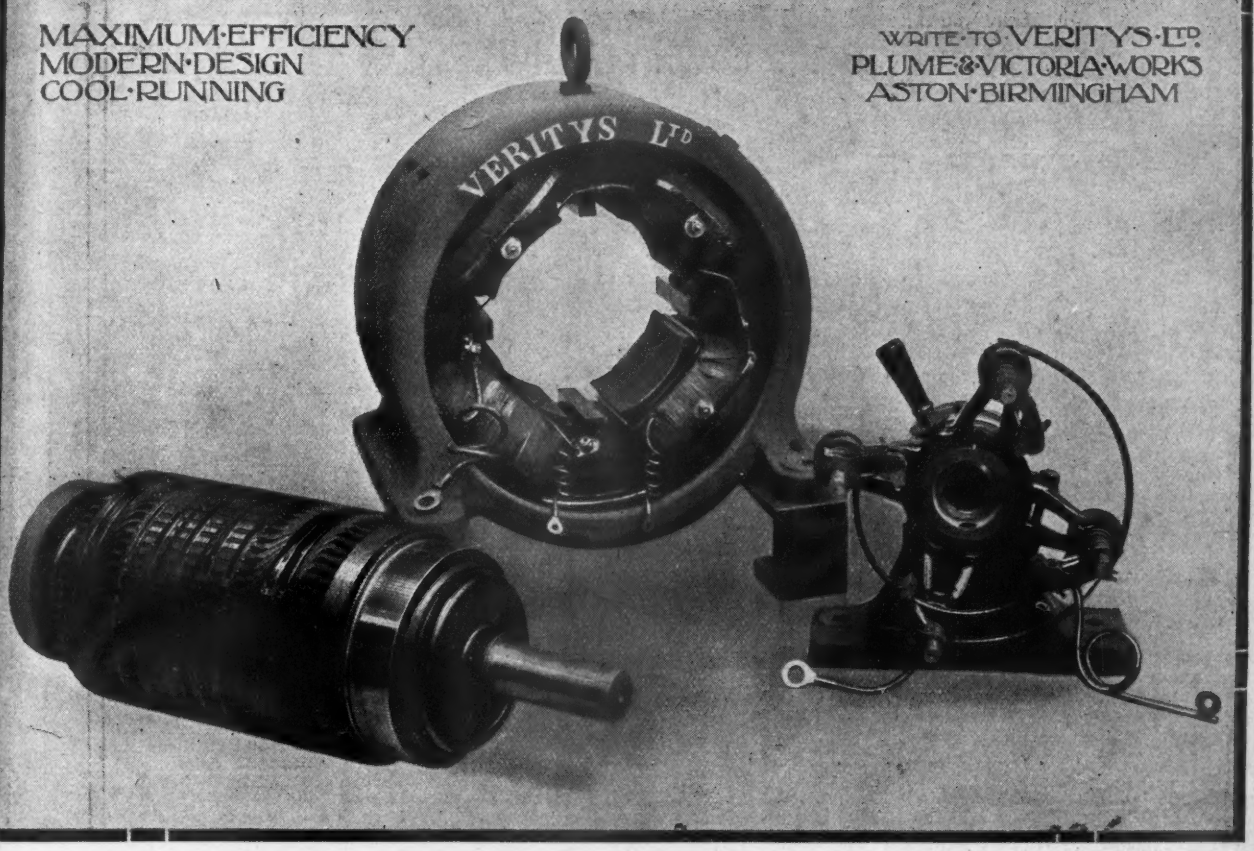

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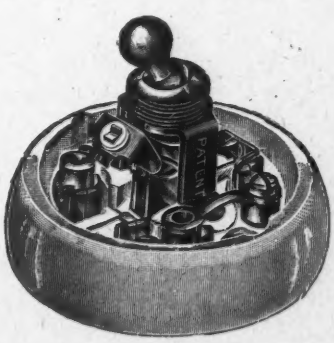

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BETWEEN
LIVE METAL & HANDLE.

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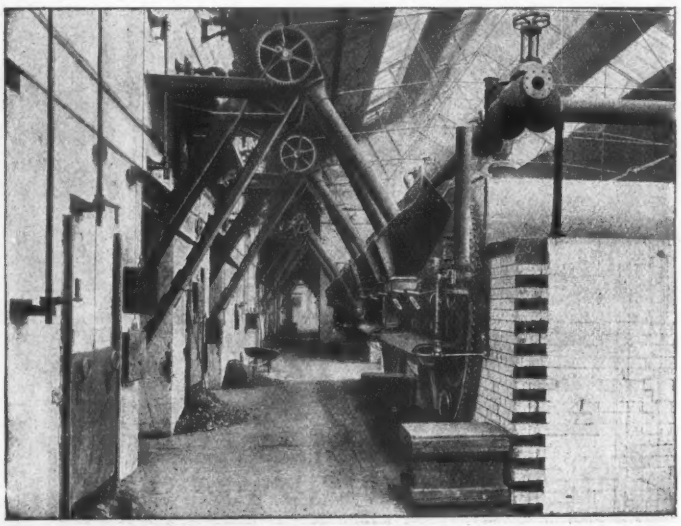
To Central Station Engineers.

BENNIS PLANT IN YOUR BOILER-HOUSE

will ensure you LOW COSTS PER UNIT, LOW FUEL COSTS;
will KEEP DOWN REPAIRS and MAINTENANCE COSTS,
and secure GOOD FINANCIAL RESULTS.



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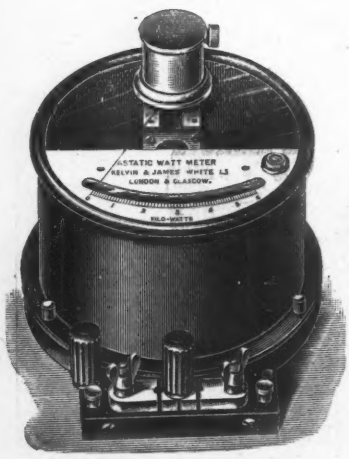

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ACCURATE ON { DIRECT OR ALTERNATING } CIRCUITS.

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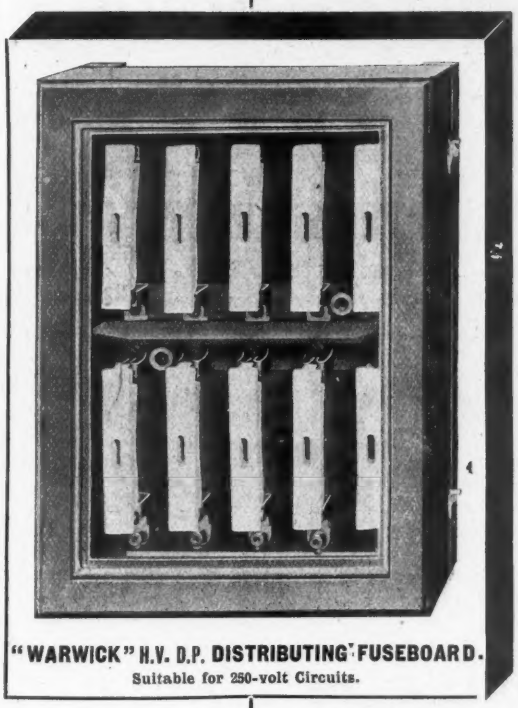

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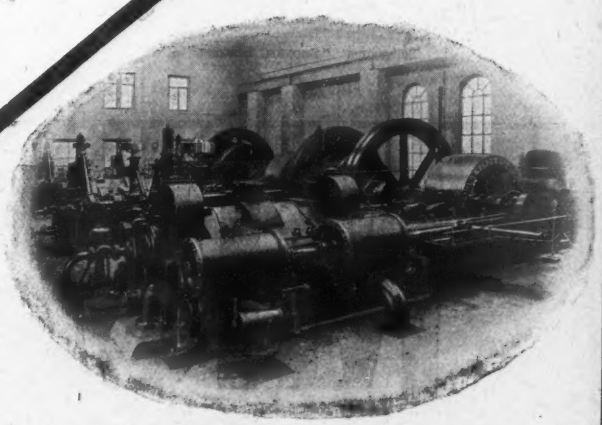

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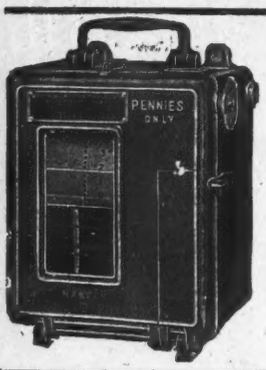

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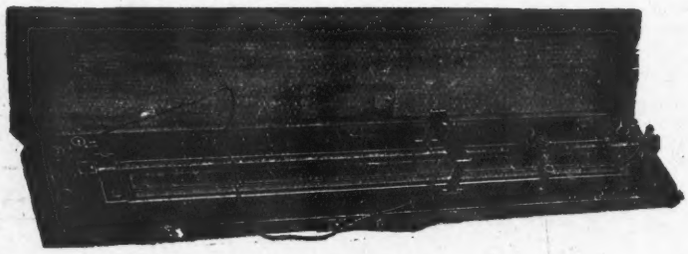

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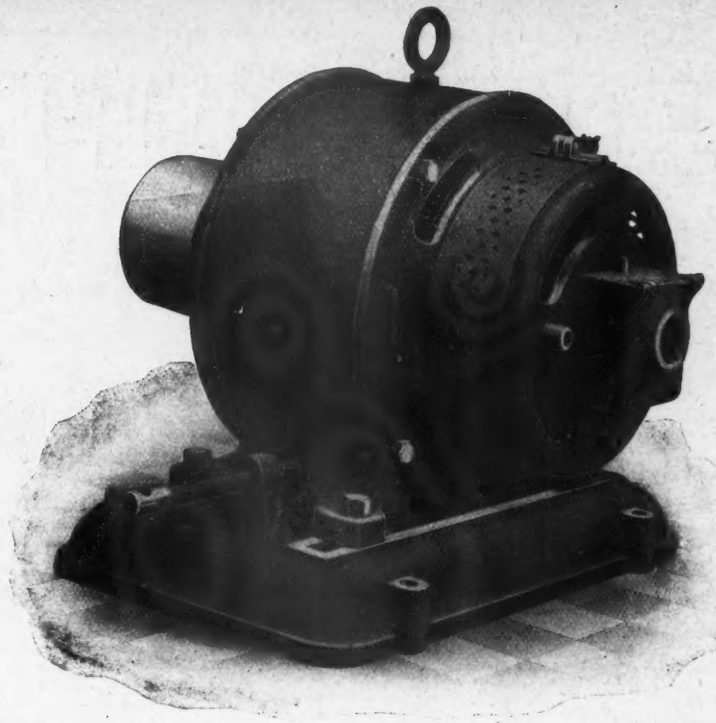

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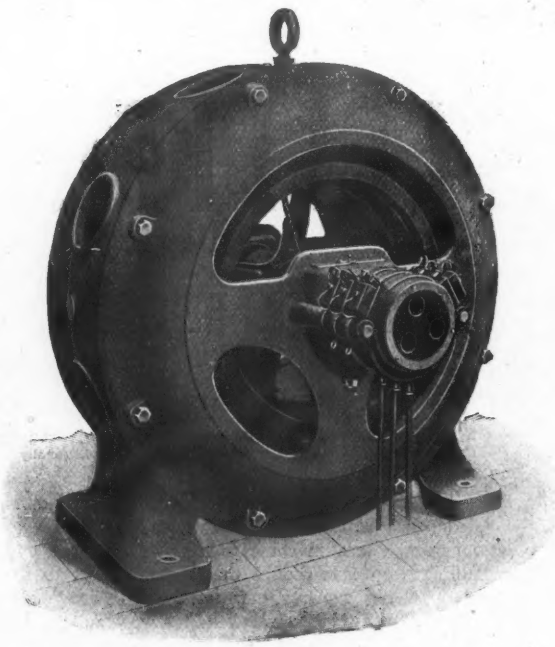

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For Plain and Screwed Conduits.

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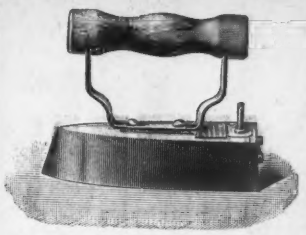

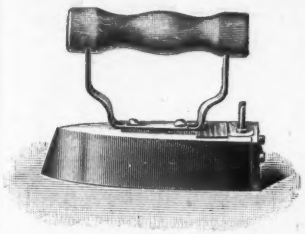

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A Steel possessing all the qualities of a 3% NICKEL STEEL at ONE-HALF THE COST. Suitable for all purposes where a Steel of high tensile strength, combined with great power of resisting shock, is required.

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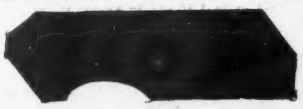

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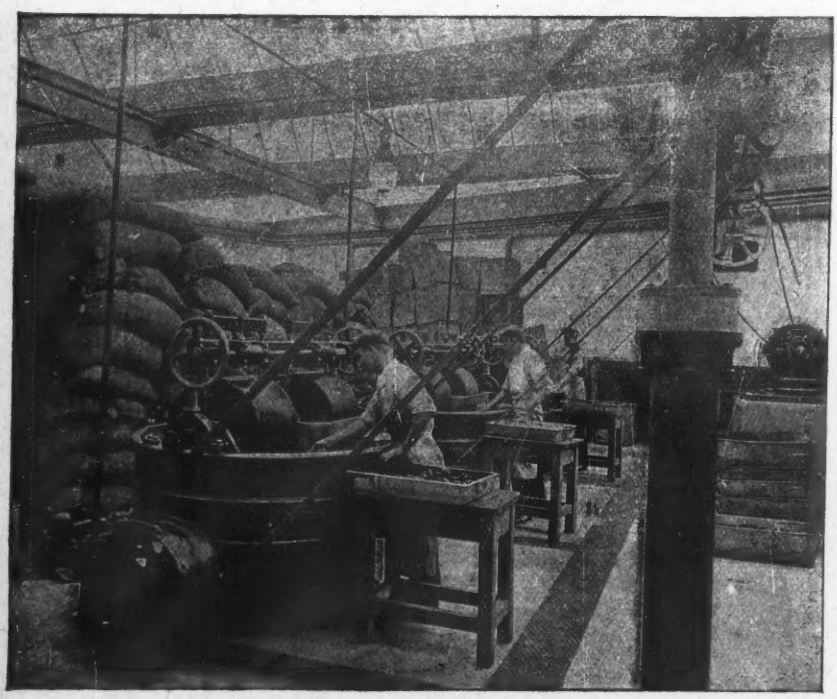

IT IS ON THE VERY ELEMENTS OF A SUBJECT THAT ILLUSTRATION IS MOST USEFULLY BESTOWED.

This illustration shows one of our

LUNDELL MOTORS

driving a LINE OF MELANGEURS.

We have installed over 1000 B.H.P. Electrical Plant in these Works.

We manufacture and supply ELECTRIC MOTORS (both alternating and continuous current) for all purposes, and our List No. 1028 gives illustrations and descriptions of a large variety of uses to which they have been put in the smaller trades.

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FOR Fees and Syllabus of Courses apply to THE BRITISH CORRESPONDENCE SCHOOL OF ELECTRICAL ENGINEERING (B. Dept.), 36, Maiden Lane, Strand, London, W.C. 6189

ELECTRICAL ENGINEER'S DEPARTMENT,

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THERE are vacancies for a few Armature Winders with good experience in continuous current work. Wages commencing at 36s. for 48-hour week.

Applications, stating age and full particulars, and copy of reference if possible, to be addressed to—

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H.M. Dockyard (North),
Devonport. 6506

SITUATIONS VACANT.—*Continued.*

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ELECTRIC POWER SUPPLY.

Junior Assistant Engineers.

IN connection with this supply, there are now further vacancies for Junior Assistant Engineers, and the Newcastle-upon-Tyne Electric Supply Company, Limited, are prepared to receive applications from apprentices out of their time or young men who have been through a college course of electricity.

Remuneration to commence at the nominal wage of 10s. per week for the first year, and 20s. per week for the second year.

Applicants will be required to sign an agreement to remain in the company's service tor two years, during which time they will pass through one or more of the large power stations, and different classes of sub-stations, and will also gain experience in other work, including distribution of polyphase and continuous current for town lighting, tramways and railways, and also power supply to large manufacturers' works.

Applications, stating age (minimum 19) and training, to be addressed to the "OPERATION DEPARTMENT," Carville Power Station, Wallsend-on-Tyne.

December 18th, 1907. 6535

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ALGEBRA.—The Correspondence School of Engineering Mathematics beg to announce that to cater for those Students who are desirous of receiving tuition in Algebra (pure) only, we have issued a Special Short Course. The Instruction Books will be forwarded to any address, and the Student registered on our books, on receipt of P.O.O. (crossed) value Five Shillings. 6464

APPOINTMENTS.—The Higher Telegraph Services afford splendid opportunities to youths and young men not content with earning 25s. to 35s. per week. For a moderate premium, permanent appointments at commencing salaries of from £150 to £190 p.a. with Pensions are secured by the London Telegraph Training College, Ltd., for its students. 28 obtained within the last eight months. Established 15 years. Wireless telegraphy a speciality, and all systems taught. Evening classes.—Write for prospectus to MANAGER ("C"), Morse House, Earl's Court. 6407

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

APPLICATIONS for Appointments prepared in forceful form, arresting attention of advertiser and strikingly successful. —Apply for particulars, HERBERT GREATOREX, 4, Oxford Road, Ilford, Essex. 6532

CLERK Wanted to assist storekeeper, used to keeping stock-books in electrical engineering trade.—6542, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CLERK required by Electric Supply Company near London, must have experience of consumers' accounts and be able to deal with meter readings; shorthand desirable. Wages 25s.—Apply with full particulars, 6536, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ENGINEERING Mathematics.—Elementary and Advanced Courses (to suit the requirements of engineers) at extremely moderate fees. Applicants can be given references to students all over the world. Tuition on approval, given free. Specimen lesson and full particulars on application to THE CORRESPONDENCE SCHOOL OF ENGINEERING MATHEMATICS, Bilston, Staffs. 6465

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IMPROVER Wanted for central station work, wages commencing at 10s. per week, advancing 5s. per week per annum to 20s.—Apply, with particulars of age, and previous training, to CORPORATION ELECTRICITY WORKS, Maidenhead. 6527

MANAGER required for branch business of a firm of London Electrical Engineers.—State full qualifications and previous experience, also salary required. Percentage of profits given to competent man.—6549, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MATHEMATICS, mechanics, machine drawing, wiring, engine testing, &c., taught by thorough postal courses. Reasonable fees.—P. T. S., 257, Granville Road, Sheffield. 6174

PREMIUM Apprentice (indoor) wanted, by firm of Contractors in South West London. Special advantages for gaining general knowledge.—Apply 6547, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

REQUIRED, Switchboard Attendant for London sub-station. One with experience of extra high-tension three-phase, and low-tension three-wire working. Salary 30s. per week of 56 hours. —Apply, stating age, experience, and date when able to commence duties, to 6546, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Junior Meter-reader and Lamp Trimmer. Wages 22s. per week of 56 hours.—Apply ELECTRICAL ENGINEER, Faversham. 6543

WANTED, at Electricity Works in Scotland, smart energetic man to erect and read meters. Preference will be given to one with some experience in cable jointing. Wages 30s. to 35s. per week.—Age, experience and testimonials to 6541, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Central Station Engineer for company undertaking, commencing salary £120 per annum. Must be prepared to invest £500 in company. State past experience, and age, with testimonials and references.—6544, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, a good Storekeeper, one accustomed to the stores of a combined traction and lighting undertaking. Commencing salary 25s. per week.—Apply 6550, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

SITUATIONS VACANT.—*Continued.*

WANTED, Draughtsman (junior) with experience in design of alternating current machinery. State full particulars and salary required.—6523, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Competent Mechanic to take charge of small machine shop turning out small parts. Must be able to make Press Tools, &c., electrical knowledge desirable, but not essential. Permanent situation to a reliable man who could show profitable output.—6468, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED for an important telephone manufactory on the Continent, a first-class Engineer to take charge of the technical department. Good prospects.—For information apply to 6492, ELECTRICAL REVIEW, 4, Ludgate Hill, London, giving particulars as to salary required, age, knowledge of languages, present situation, references, &c.

WANTED Two Switchboard Attendants to commence work in the New Year, experience with extra high-tension three-phase generating plant essential. Experience of continuous-current lighting and traction switchboards desirable. Wages 26s. rising to 30s.—Apply ENGINEER, Electricity Works, Wolverhampton. 6484

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APPOINTMENTS FILLED.

NO. 6216.—Applicants are thanked for their letters, and advised that the situation has now been filled. 6540

WE beg to inform applicants to the Advertisement No. 6233, November 29, that the vacancy for working electrician has now been filled. 6537

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Latest time for receiving, 9.30 a.m., Thursday.

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ADVERTISER requires re-engagement as Meter Reader and Inspector; eight years' experience; highest references.—6526, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS WANTED.—*Continued.*

ADVERTISER (36) married, disengaged January 1st, requires charge of gas or oil engines, electric light; thoroughly acquainted with suction gas plants, sanitary engineering, estate or otherwise. Highest references.—6425, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

BUYER, Assistant, excellent experience with electrical and mechanical engineering concern, desires change.—6545, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

COMMERCIAL Engineer, 17 years' experience, now managing London concern, open to re-engagement next February.—6223, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN desires engagement; many years' experience in wiring and in erecting and maintaining lighting and electrical power plants in large factories and works.—6430, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Instrument Makers require work, own shop and tools.—6409, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMAN (24) disengaged; all systems; any distance.—TOMLIN, 9, Croft Road, Wallingford. 6455

WIREMAN disengaged, experienced. Casing, simplex, barrel.—H., 14, Sterndale Road, West Kensington. 6551

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THE MANUFACTURERS of a first-class British Incandescent Electric Lamp invite applications for the—

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CABLES.—Wanted by large Cable Manufacturers, several well-known Wholesale Houses in West of England as Agencies.—Apply, 6482, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

INDUSTRIOUS Firm at Paris is looking out for the Sole Agency of all kinds of Isolating Materials, Tools, and Machinery for Tools.—Apply to P. Métivier & Cie, 94, Rue de la Victoire, Paris. 6488

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CONSULTING.—An Electrical Engineer, M.I.E.E., with extensive experience in responsible positions in power, municipal, contracting, estimating and designing work; could provide capital for active Partnership in first-class established consulting practice. Replies absolutely confidential.—6496, ELECTRICAL REVIEW, 4, 4, Ludgate Hill, London.

ENGINEER, technical training and electrical experience, wishes position in electrical or engineering firm, or allied business, with ultimate view to Partnership.—"Z. T. 713," Messrs. Deacon, Leadenhall Street, London. 6487

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BUYERS AND SELLERS
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ELECTRIC LIGHTING AND POWER PLANTS
in good running order
are requested to communicate with
WHEATLEY KIRK, PRICE & Co., 46, Watling Street, London, E.C.

CASH BUYERS AND SELLERS
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Also Machine Tools and Miscellaneous Plant.
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FOR SALE.—*(Continued).*

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DYNAMO, 230 v. 325 a. 560 r.p.m., compound wound; six poles, three bearings, and new spare armature; price £150. —MARTIN, Electrical Engineer, Kidderminster. 6226

EIGHTY Dynamos and motors for sale or hire.—MARTIN, Electrical Engineer, Kidderminster. 6499

ELECTRICAL Engineers of all grades should buy the Practical Electrician's Pocket Book (1908) at once. Revised and still further enlarged. The standard pocket book for the man who wants to get on. Cloth 1s. 2d., leather 1s. 8d. (with insurance), from RENTELL, Publisher, London. 6481

FLAME Arc Lamps.—Four 10 amp., been used temporarily, practically new. Motor, 40 amps., 110 volts. Offers.—PUDNEY, Bury St. Edmonds. 6493

FOR Sale, two 50 B.H.P. Motors, 400 volts, 600 revolutions, spare Armature, two Controllers, with two speeds ahead and two speeds astern; 350 Cells in ebonite boxes, 450 ampere-hours capacity; also two Fans and Ventilating Trunks from battery compartments.—Apply J. T. MEARS, The "Old Ship," Richmond, Surrey. 6431

FOR Sale.—65-KW. Generator with Engine combined; engine by Willans & Robinson, 11" × 15½" × 9" stroke; generator by Mather & Platt, 420 to 450 volts, 150 amps. 50-KW. direct-coupled Generating Set (by Brush Electrical Eng. Co.), with Auto Compound Universal Type Engine, compound-wound Generator, 500 to 550 volts. Electric Hoist, with 23 brake H.P. Motor, drum 3' 6" diam., 15" wide, 21 grooves. Armature Disc Cutting and Notching Plant, to admit 24" diam. in gap. New detailed Catalogues post free on application.—THOS. W. WARD, LTD., Albion Works, Sheffield. 2579

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WANTED TO PURCHASE FROM ELECTRIC LIGHTING Companies and Electrical Engineers, Dynamos, Motors, Cable, Wire, Instruments, and every description of Electrical Material, also Manufacturers' Surplus Stocks. The bulk being for re-use, high cash prices can be paid.—A. VEREY & Co., Dover. Principal in London three days a week. Telegraphic Address: "Verey, Dover." 8514

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BEST Price given for any kind Asbestos Scrap.—WILTON, Bramley, Leeds. 6405

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WANTED, any quantity Scrap Gutta-Percha Covered Wire or Scrap Cables. Samples and lowest price for cash.—FORD AND Co., Warrington. 6408

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ARTICLES WANTED.—*Continued.*

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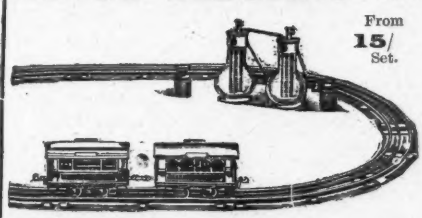

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Card Index to Important Articles Appearing in the "Electrical Review" of November 29, December 6, 13 and 20, 1907.

Brakes: Tramway Brake Developments in Leeds. *Illus.*
Elec. Rev. 61, November 29, 1907, pp. 899-901

Cables: Notes on Drawing-in Cable. By W. Pleasance. *Illus.*
Elec. Rev. 61, November 29, 1907, pp. 912-913

Education: The Trade School Problems of Skilled Labour. By C. A. Smith. Elec. Rev. 61, November 29, 1907, pp. 910-911

Electromobiles: The Electromobile Co.'s New Garage. *Illus.*
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Exhibition: The 1908 Electrical Exhibition at Manchester.
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Lighting: Discrimination in Factory Lighting.
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Elec. Rev. 61, November 29, 1907, p. 879

Power: Electrical Driving in a Cloth Factory.
Elec. Rev. 61, November 29, 1907, pp. 911-912

Testing: The Magnetic Testing of Iron. By W. H. F. Murdoch. (I.E.E.). *Illus.*
Elec. Rev. 61, November 29, 1907, pp. 885-886
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Traction: Comparative Performance of Steam and Electric Locomotives. By A. H. Armstrong. *Illus.* (Am.I.E.E.).
Elec. Rev. 61, November 29, 1907, pp. 883-885

Trade and Commerce: Exports and Imports of Electrical Goods during October, 1907.
Elec. Rev. 61, November 29, 1907, p. 909

Electro-Metallurgy: Electrometallurgical Operations.
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Industry: The German Electrical Industry.
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Lighting: The City Lighting. By Haydn Harrison. *Illus.*
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Lighting and Power: Tactics for Electricity Salesmen.
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Lighting and Power: Prepayment Supply. By Central Station Man.
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Elec. Rev. 61, December 6, 1907, pp. 950-951

Parliamentary: New Electrical Schemes to come before Parliament.
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Picture Telegraphy: The Belin System of Telephotography. *Illus.*
Elec. Rev. 61, December 6, 1907, pp. 938-939

Power: The Production of Power from Peat. By T. Tomlinson. (I.E.E. Dublin).
Elec. Rev. 61, December 6, 1907, pp. 953-954

Pumping: Electrically Operated Pumping Plants. By T. L. Kolkin. *Illus.* Elec. Rev. 61, December 6, 1907, pp. 920-921

Tramways: Tramway Developments in Buenos Ayres. *Illus.*
Elec. Rev. 61, December 6, 1907, pp. 935-937

Canal Inquiry: The. Elec. Rev. 61, December 13, 1907, pp. 989-991

Cranes: Some Modern Warehouse Cranes. *Illus.*
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Lighting and Power: The Practical Operation of Mercury Vapour Rectifiers. *Illus.* Elec. Rev. 61, December 13, 1907, pp. 994-996

Lighting and Power: The Electrical Installation at the Royal Victoria Infirmary, Newcastle-on-Tyne. *Illus.* Elec. Rev. 61, December 13, 1907, pp. 975-978

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Mining: Electrical Mining Plant. *Illus.* Elec. Rev. 61, December 13, 1907, p. 975

Tramways: A New Radial Truck. *Illus.* Elec. Rev. 61, December 13, 1907, p. 979

Turbo-Generators: The Development of Turbo-Generators. By Dr. R. Pohl. *Illus.* (I.E.E.) Elec. Rev. 61, December 13, 1907, pp. 991-993

Dynamos: The Influence of Rated Speed and Output on the Design of Continuous Current Generators. By H. M. Hobart. *Illus.* Elec. Rev. 61, December 20, 1907, pp. 1029-1332

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Lighting and Power: Electrically Equipped Railway Shops in the Argentine. *Illus.* Elec. Rev. 61, December 20, 1907, pp. 1015-1019

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Power: The Electrical Operation of Textile Factories. By H. W. Wilson. (I.E.E.) Elec. Rev. 61, December 20, 1907, pp. 1006-1008

Pumping: Electrical Pumping Installations. *Illus.* Elec. Rev, 61, December 20, 1907, pp. 1033-1034

Training of Engineers: The Chief in Embryo. By R. Elec. Rev. 61, December 20, 1907, pp. 1034-1035

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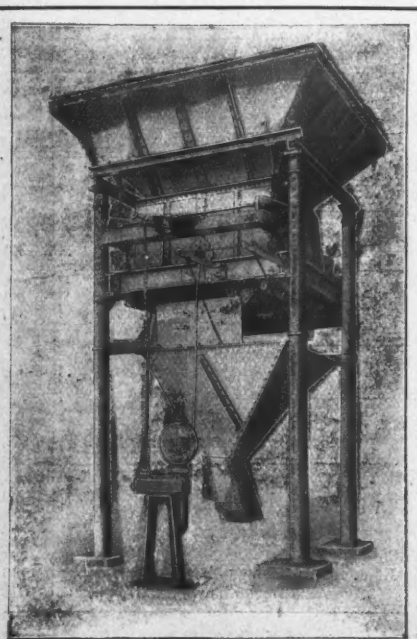

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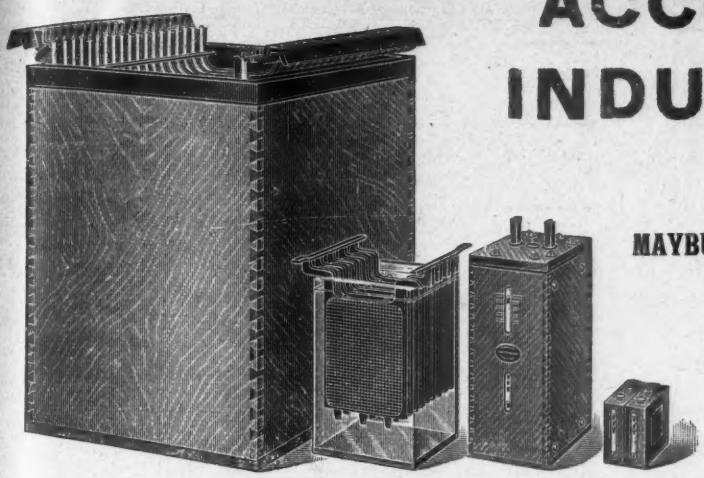

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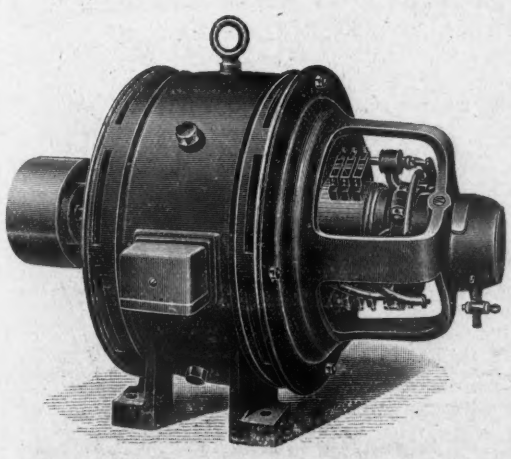

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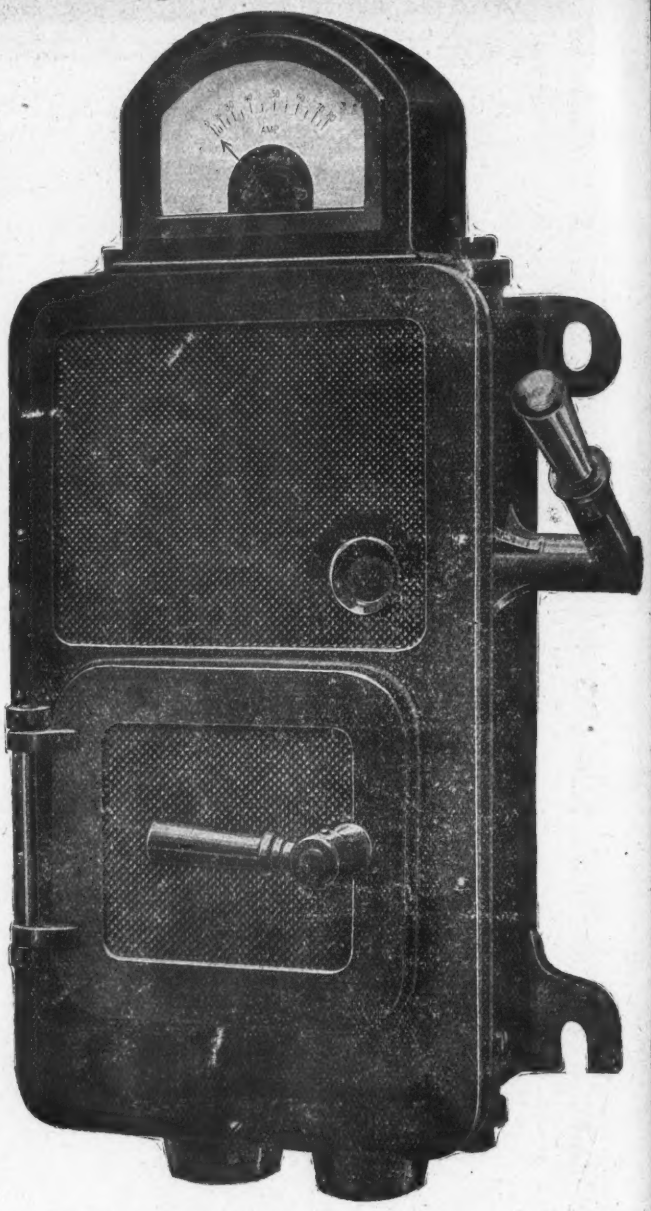

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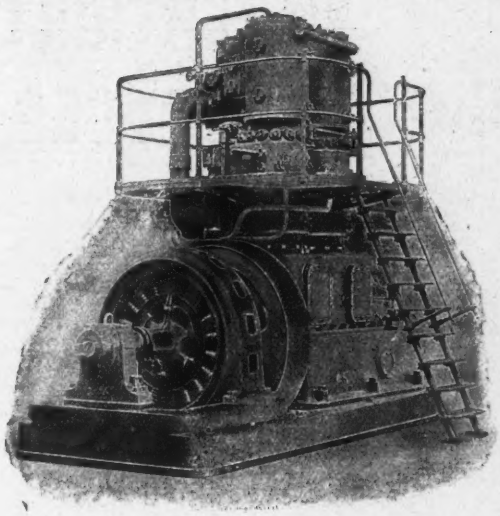

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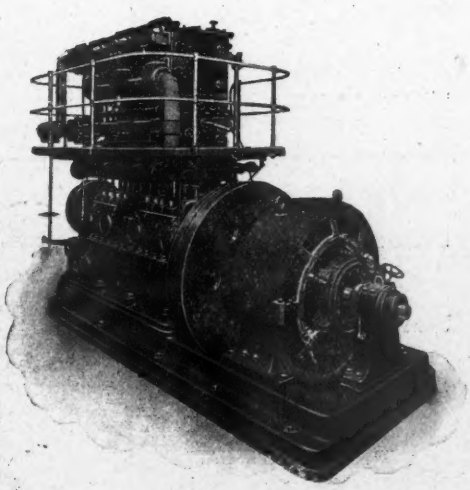

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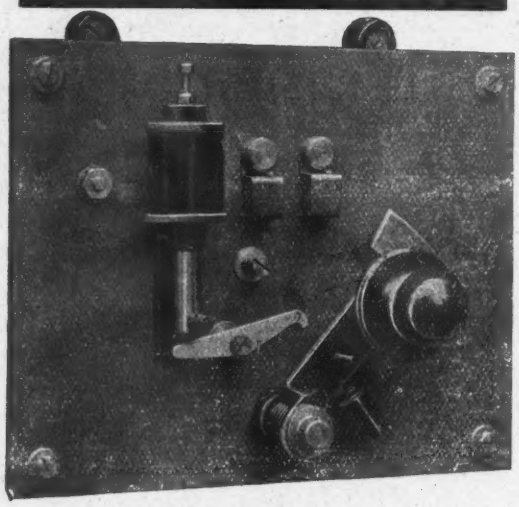

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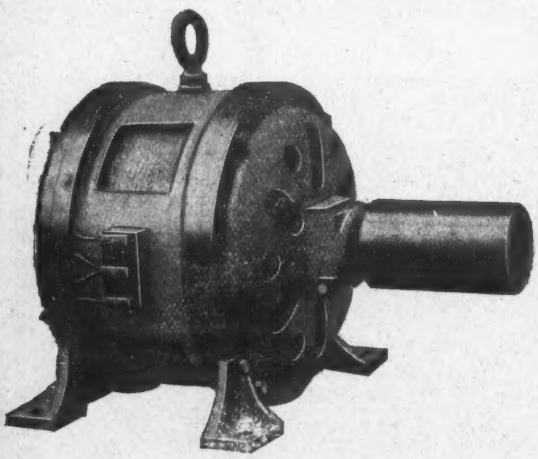

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One 350-kilowatt High Speed Engine and Dynamo combined, together with spare parts.

Plans may be seen and Conditions, Specification, and Form of Tender obtained at the offices of the Electrical Engineer to the Council (Mr. E. CALVERT), Electricity Works, Squire's Lane, Finchley, N., on and after the 18th instant on payment of Two Guineas, returnable on receipt of *bonâ fide* Tender.

Sealed Tenders, marked "Extensions, Electricity Works, Section XLIII," to reach me, the undersigned, before 5 p.m., on MONDAY, the 20th JANUARY, 1908.

Dated this 14th day of DECEMBER, 1907.

E. H. LISTER,
Clerk to the Council.

Council Offices,
Church End, Finchley, N. 6509

TO ELECTRICIANS AND OTHERS.

THE METROPOLITAN ASYLUMS BOARD invite Tenders for Installation of Electric Lighting, &c., in the Motor Workshops and Yard at the Mead Ambulance Station, Carnwathe Road, Fulham, S.W., in accordance with Drawing and Specification prepared by Mr. W. T. HATCH, M.Inst.C.E., M.I.Mech.E., Engineer-in-Chief.

The Drawings, Conditions of Contract, Specification, and Form of Tender, may be inspected at the Office of the Board, Embankment, London, E.C., on and after 10 a.m. on Monday, 23rd December, 1907, and can then be obtained upon payment of a deposit of £2. The amount of the deposit will be returned only to persons who have sent in *bonâ fide* Tenders and returned the Drawings and Specifications in accordance with the instructions.

Tenders from thoroughly reliable firms only will be entertained. Tenders, addressed as noted on the form, must be delivered at the Office of the Board not later than 10 a.m. on WEDNESDAY, 8th JANUARY, 1908.

By Order,
T. DUNCOMBE MANN,
Clerk to the Board.

17*th, December*, 1907. 6514

OFFICIAL NOTICES.—*Continued.*

KILKENNY DISTRICT LUNATIC ASYLUM.

ELECTRIC LIGHTING.

THE JOINT COMMITTEE OF MANAGEMENT are prepared to receive Tenders for the following work in connection with the lighting of the Asylum :—

Section 1.—Suction Gas Plants, Gas Engines, Electric Generators.

Section 2.—Accumulators, Switchboard, Underground Mains, Wiring and Fittings.

Plans may be inspected by appointment at the Asylum or at the office of the Consulting Engineer, Mr. LOUIS J. LAWLESS, A.I.E.E., 27, Castlewood Avenue, Rathmines, Dublin, from whom General Conditions, Form of Tender and Specification may be obtained on payment of Three Guineas, which will be returned on receipt of a *bonâ fide* Tender.

Sealed Tenders, endorsed "Tenders for Electric Lighting," are to be addressed to the Resident Medical Superintendent, District Asylum, Kilkenny, Ireland, and received by him on or before the 18th JANUARY, 1908. 6525

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31, LOMBARD ST., E.C. (*Established 1860*). | MILLWALL DOCKS, LONDON, E.

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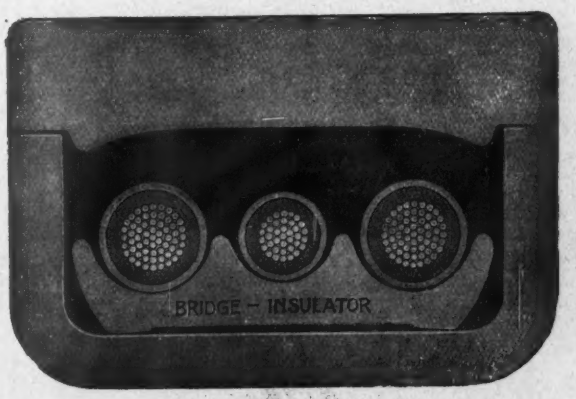

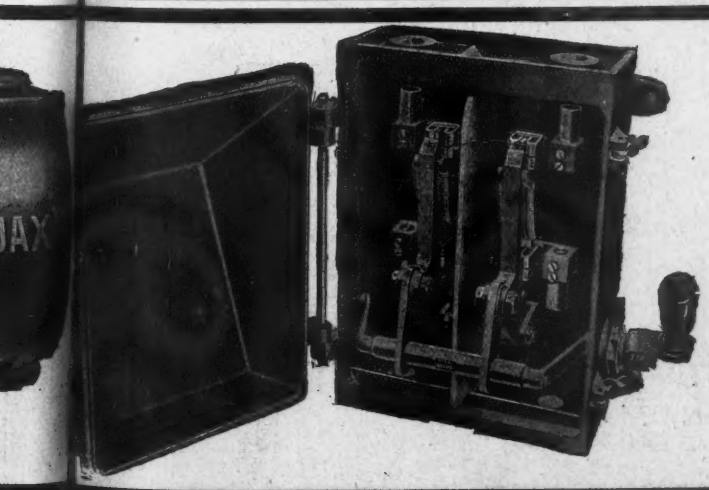

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(2) Switch cannot be operated until cover is entirely closed.

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Hulme Electrical Works,

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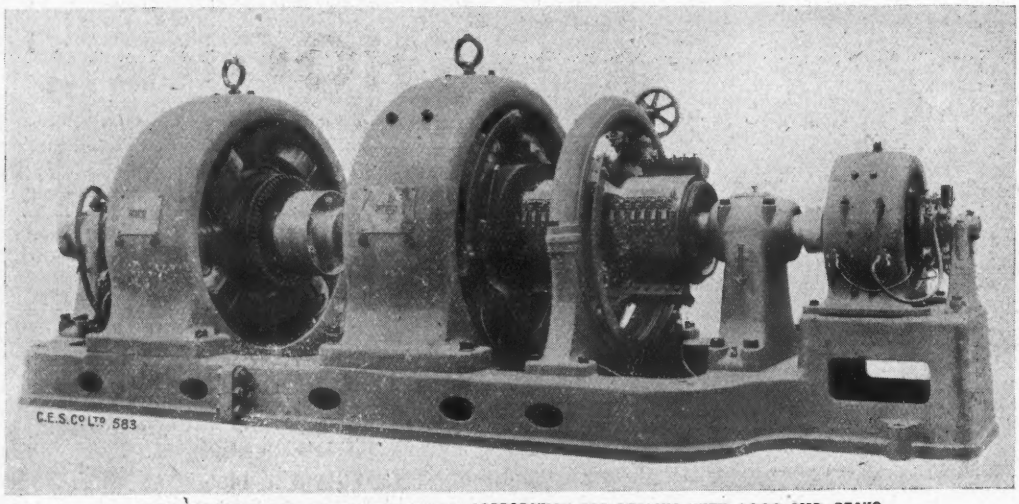

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2, Collingwood Street,
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43a, High Street, BELFAST.
3, Arcade Chambers,
St. John's Square, CARDIFF.

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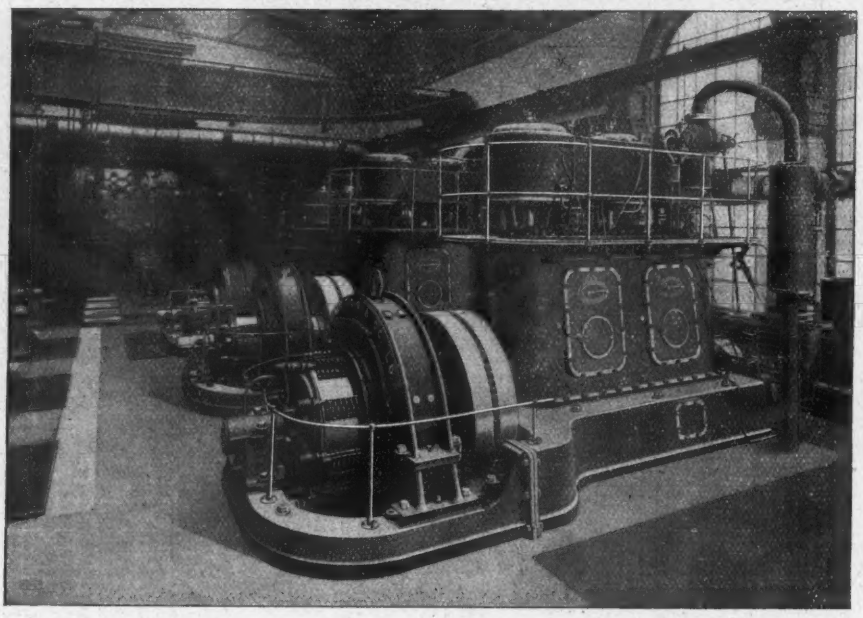

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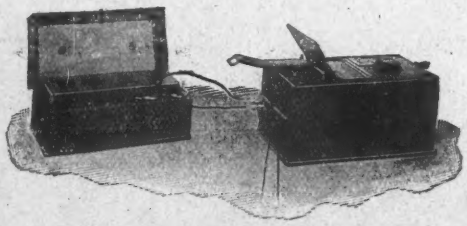

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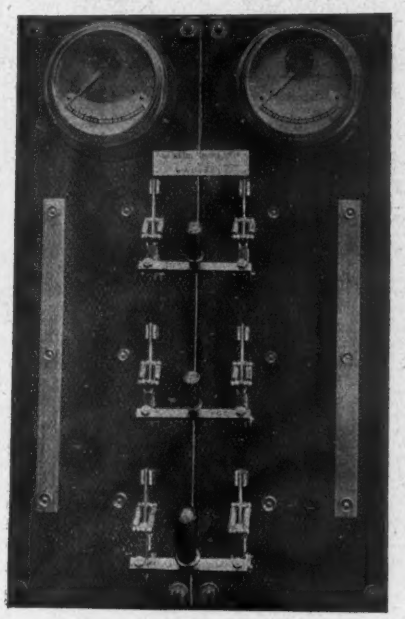

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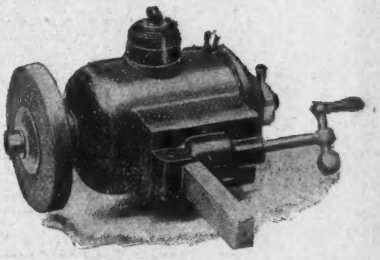

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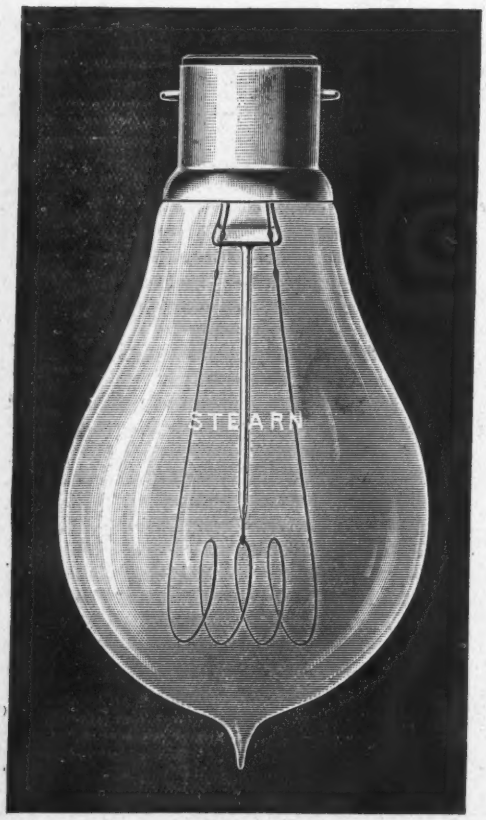

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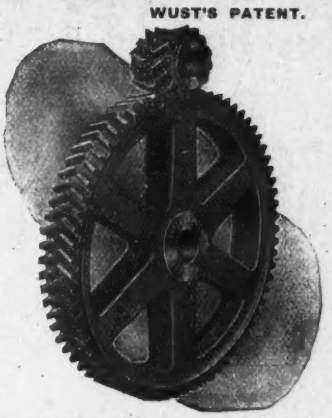

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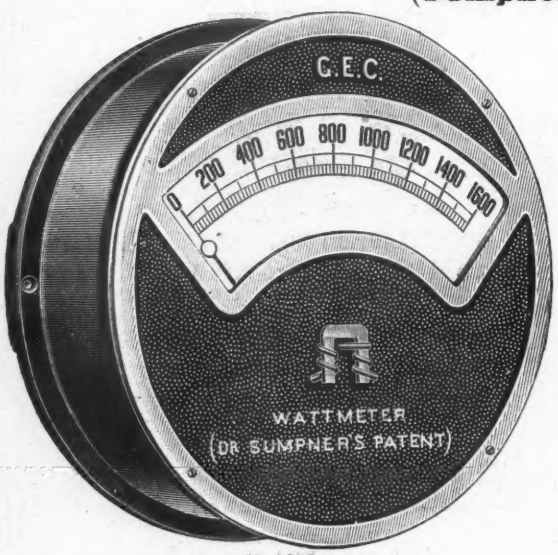

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Catalogue Corner

This Week's Issues:

No. 1209. "General" Electrical Progress.
January (1908) Number. (Second Quarterly Issue).

F 1218. Fittings and Glassware for "OSRAM" Lamps. (12 pp.).

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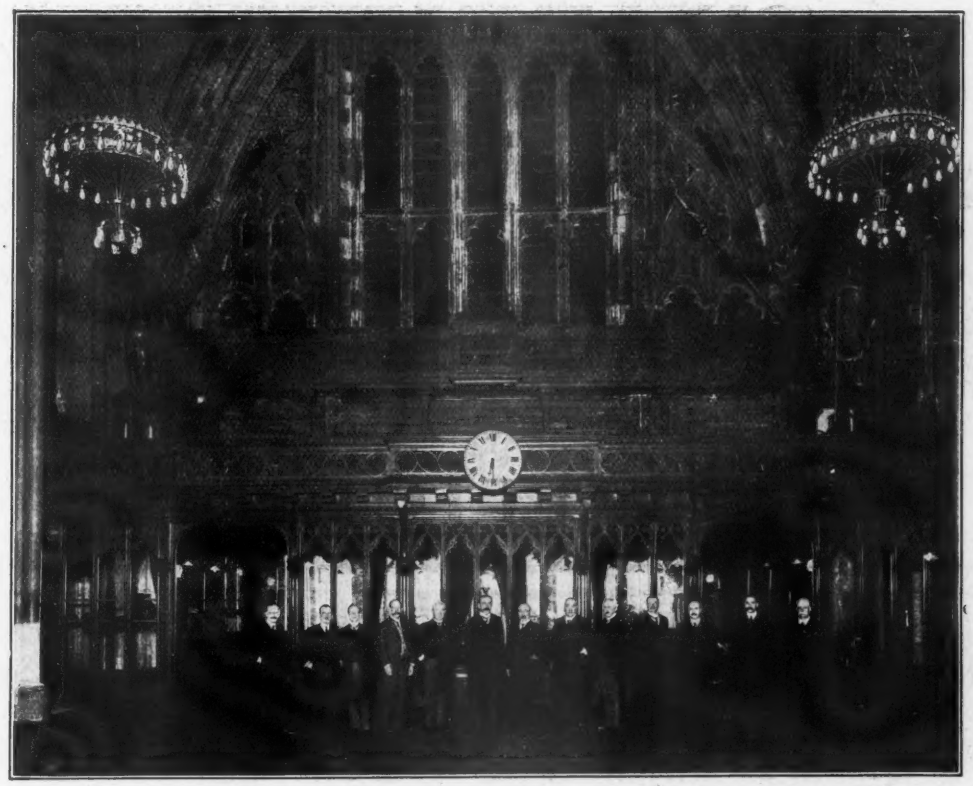

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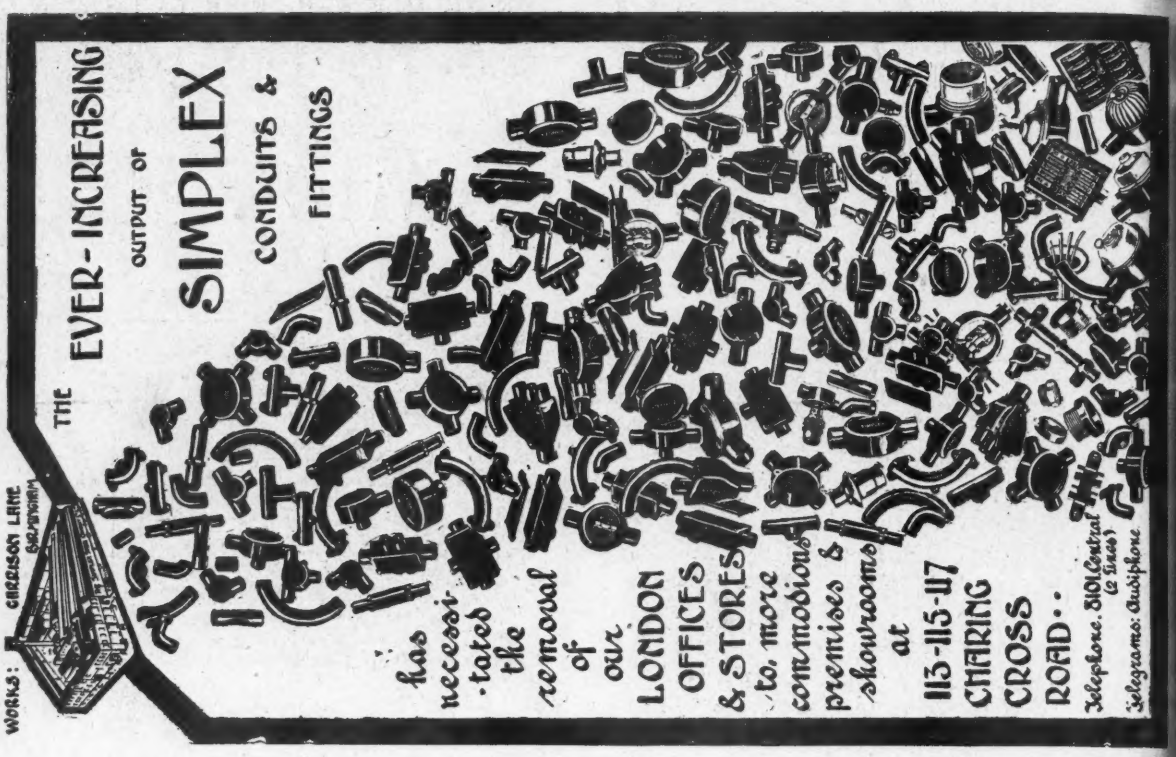
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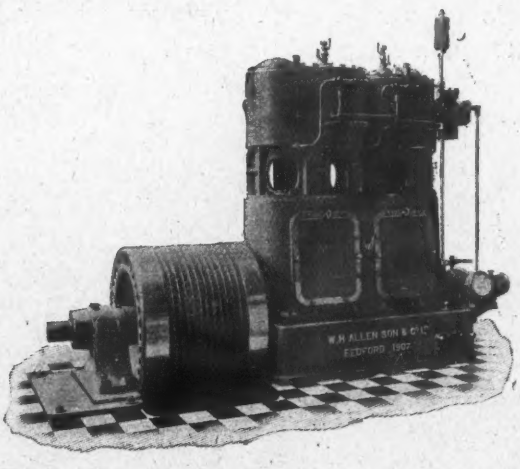

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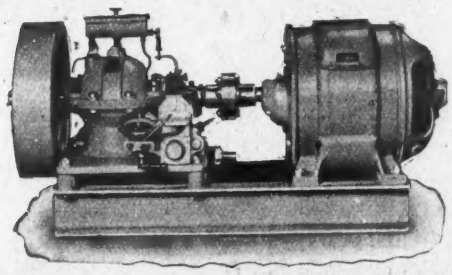

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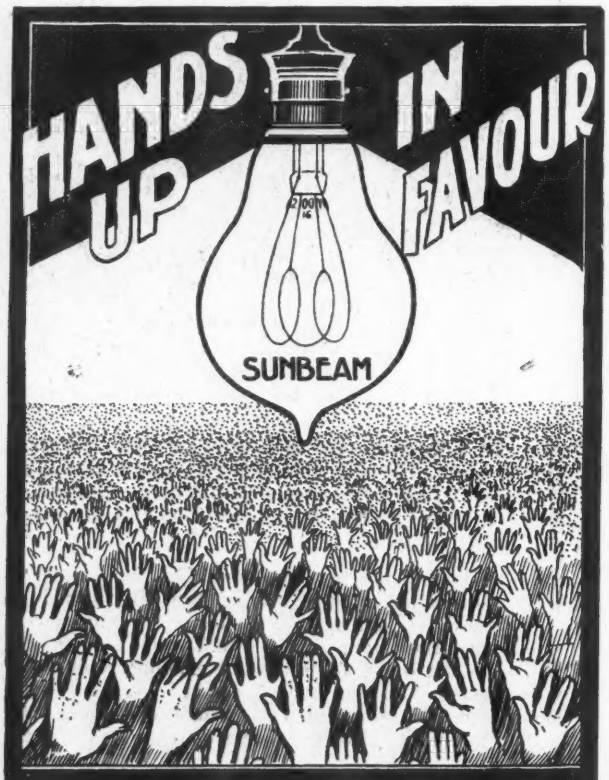
NEW ZEALAND: 4, Dixon Street, Wellington.
AUSTRALIA: Temple Court, 146, King Street, Sydney.



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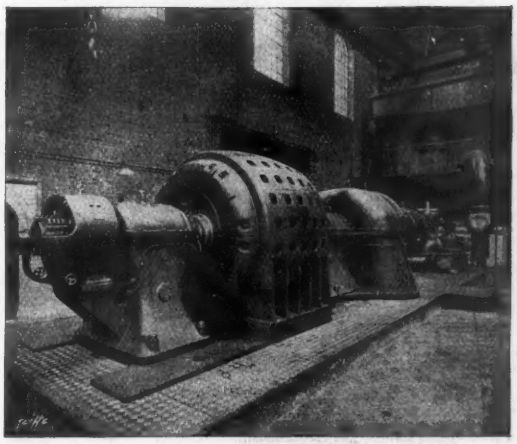

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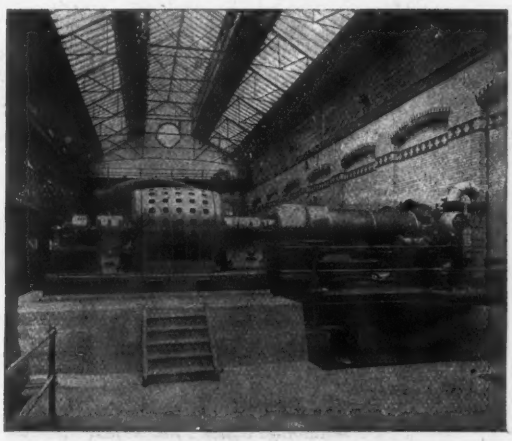

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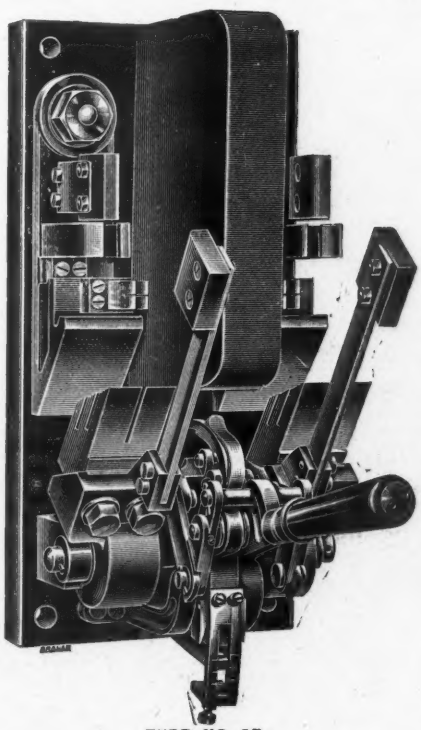

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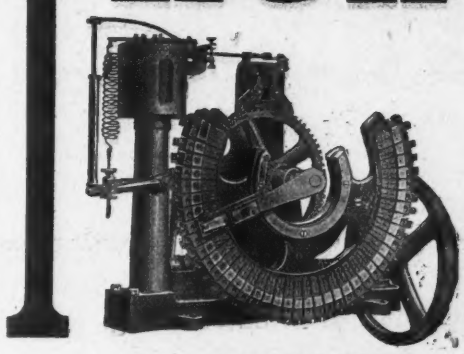

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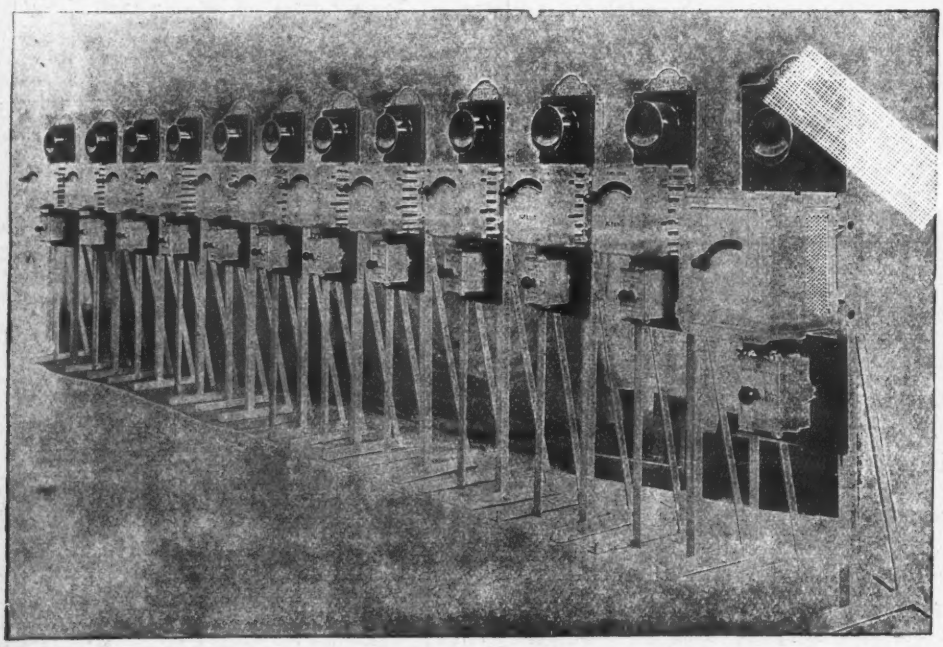

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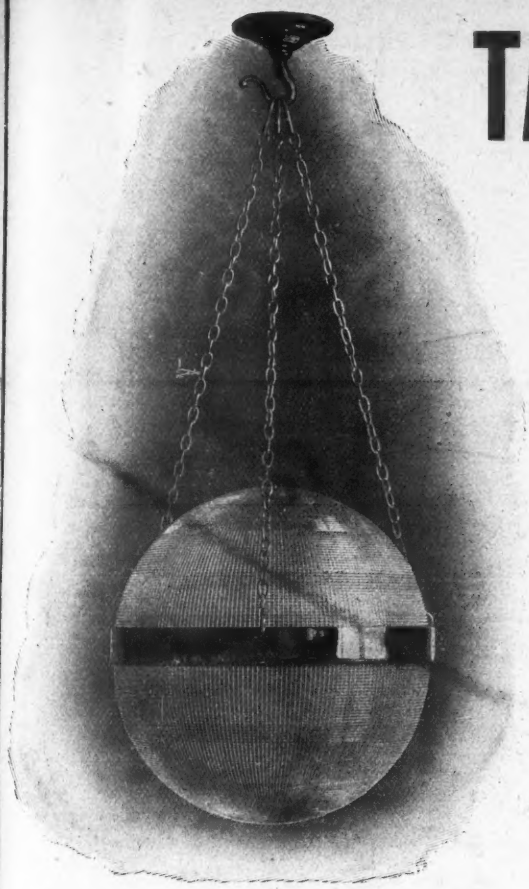

Fig. 15.
SPHERE or HEMISPHERE FITTING.
Holophane Glass.

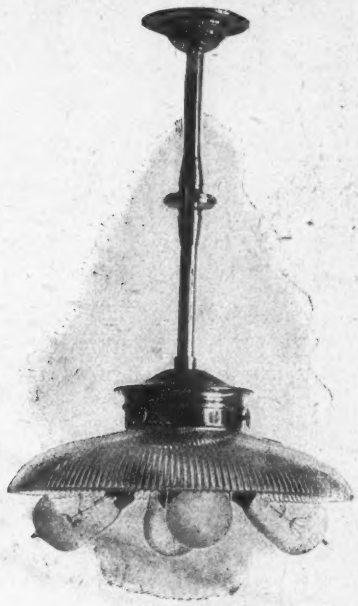

Fig. 14a.
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Fig. 17.
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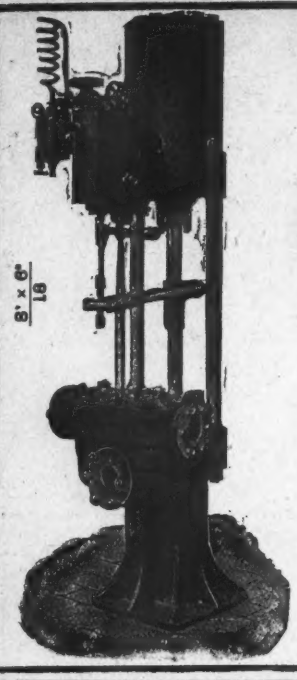

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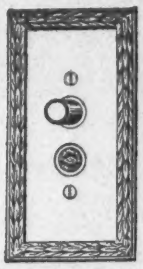
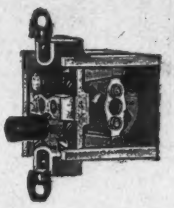


Face Plate, Louis XV., as supplied to Hotel Ritz.



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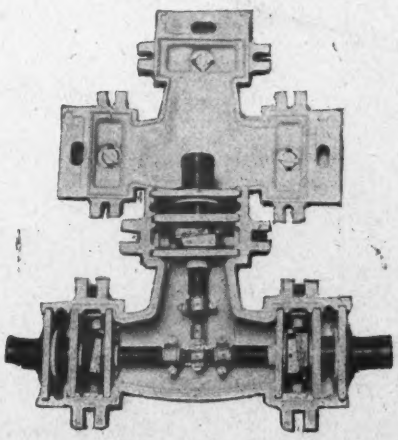

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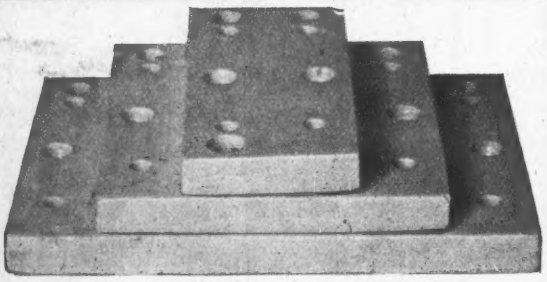

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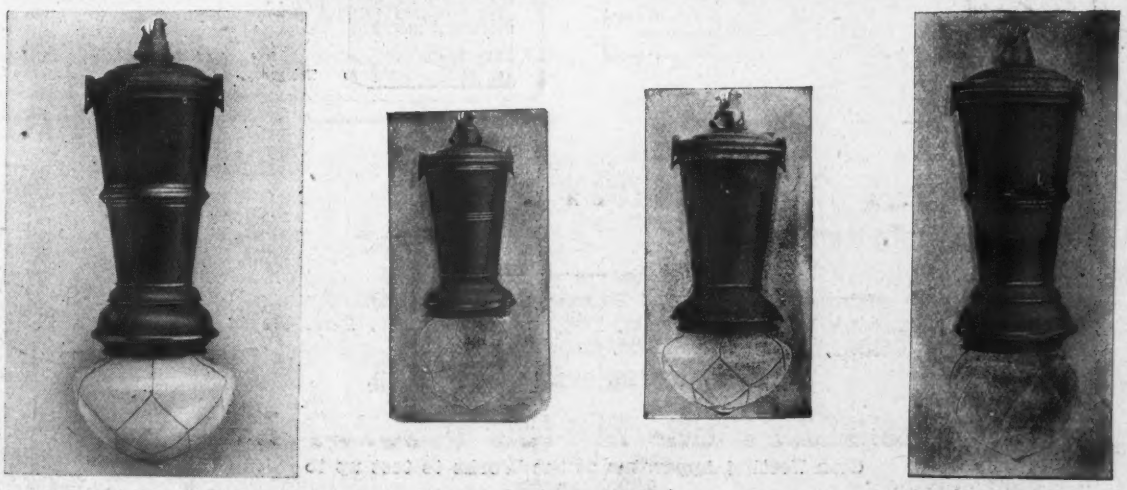

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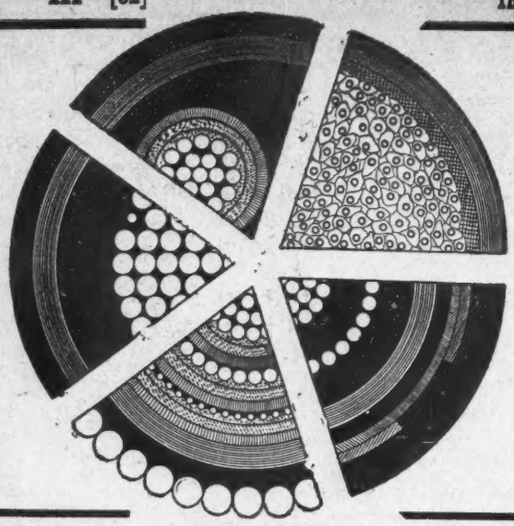

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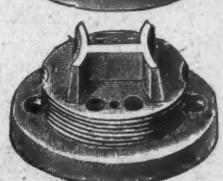

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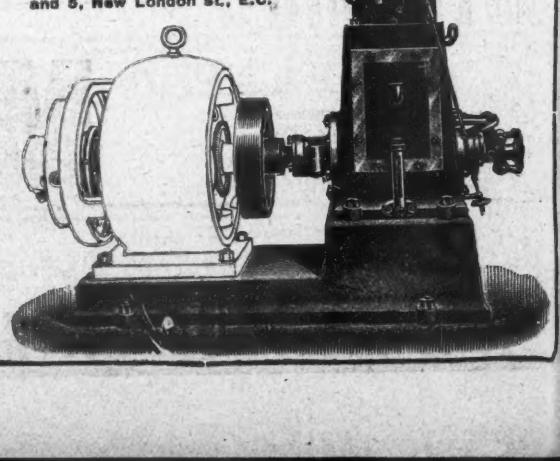

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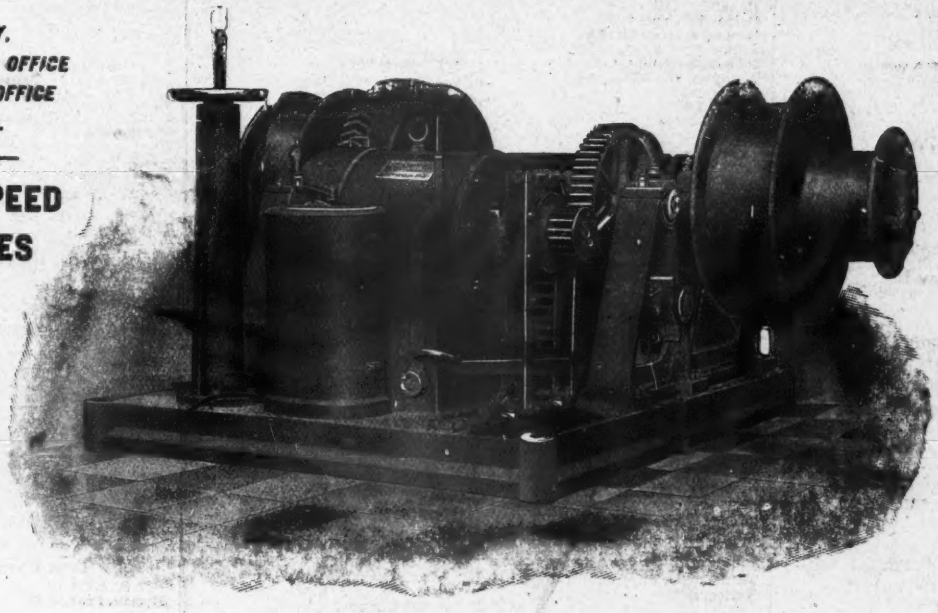

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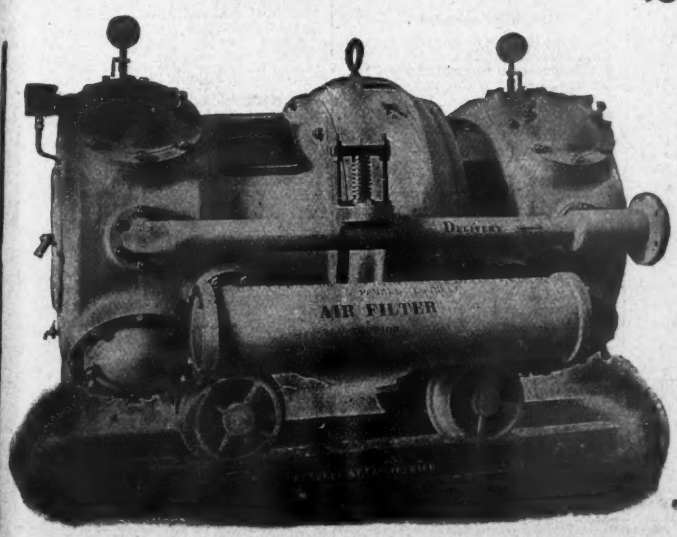

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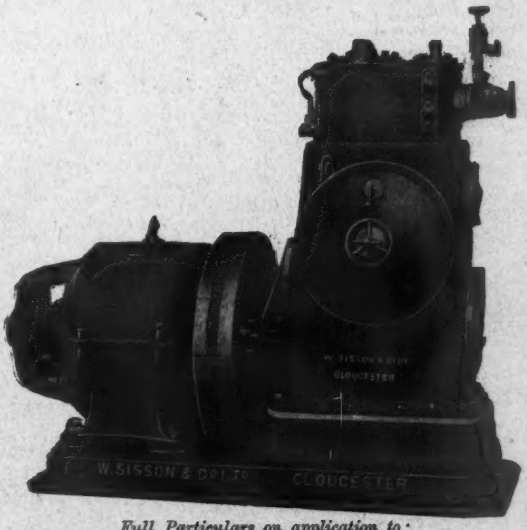

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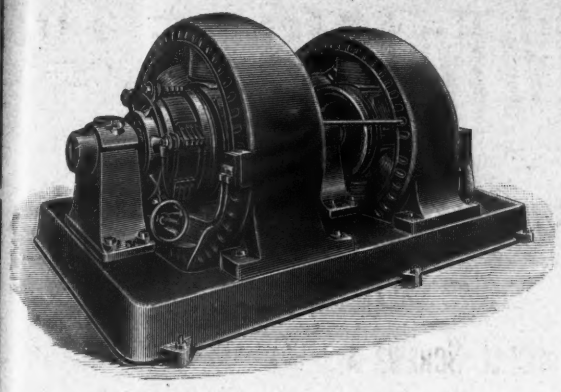

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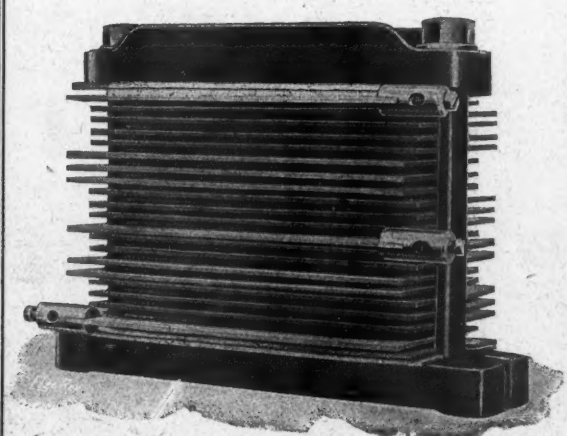

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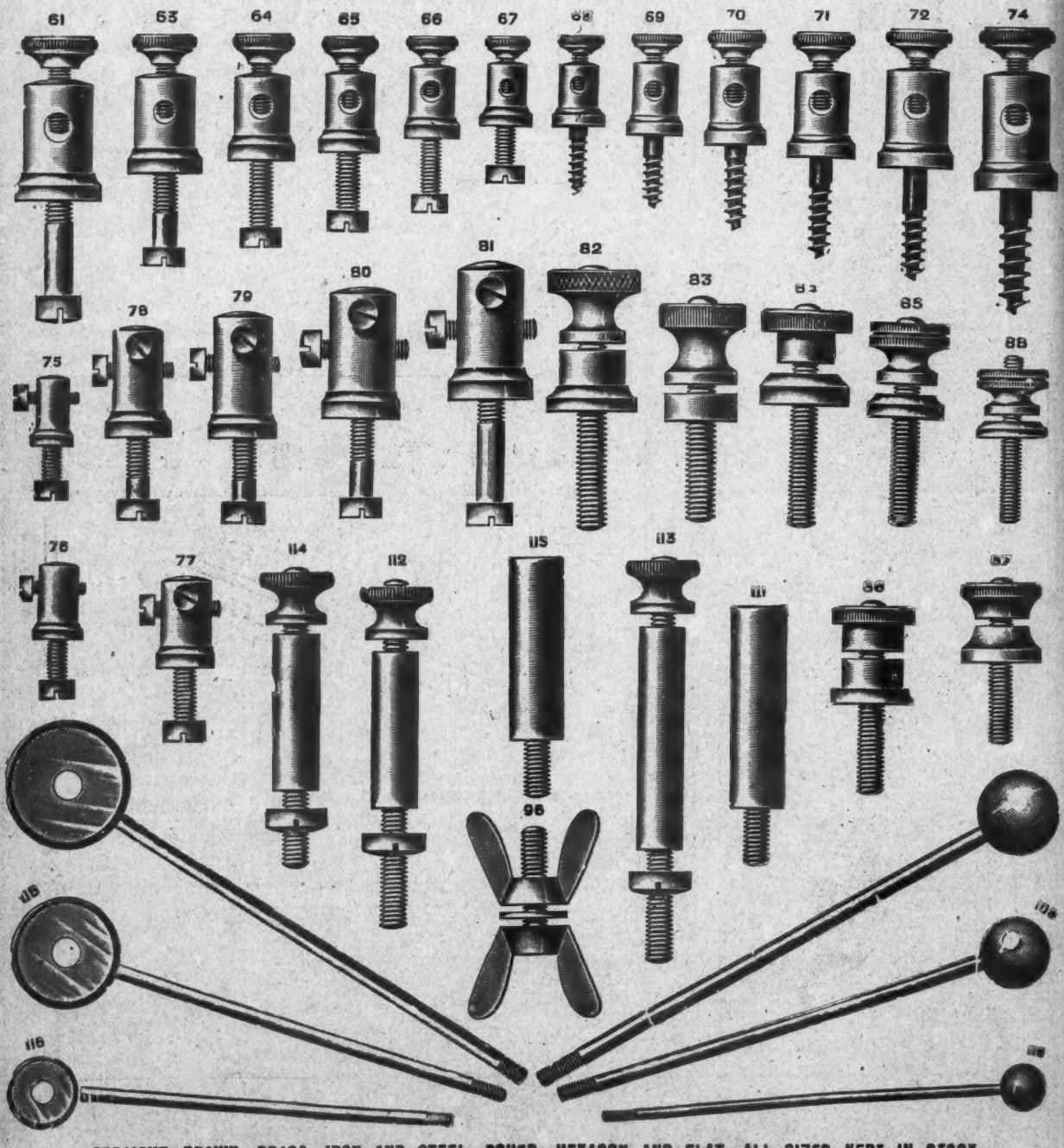

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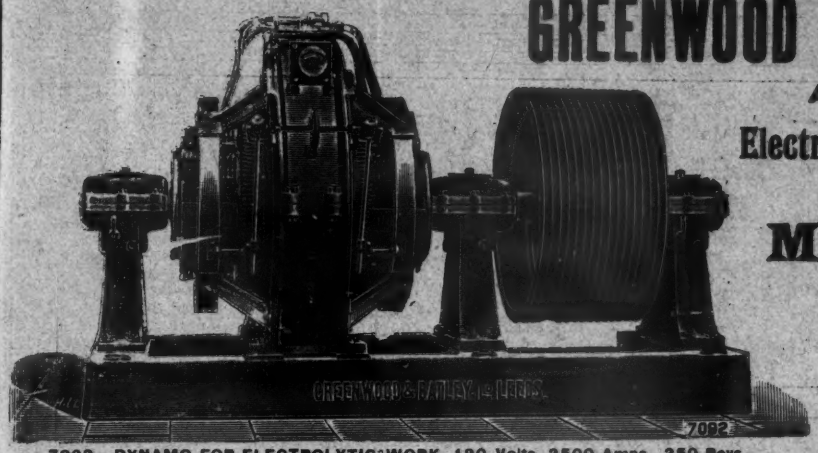

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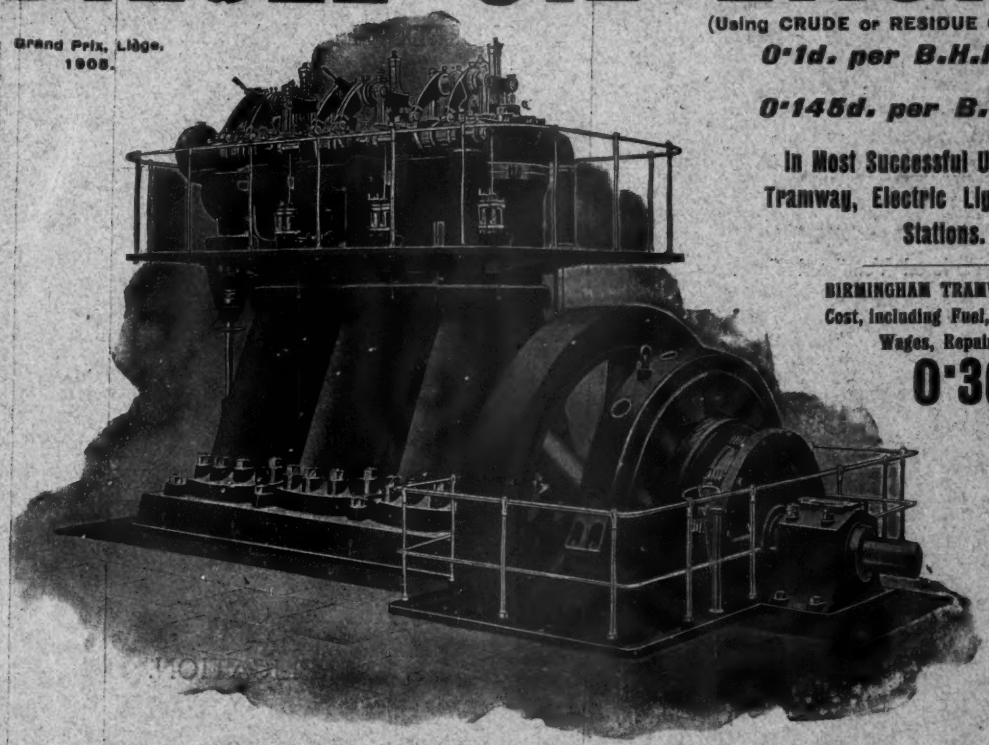

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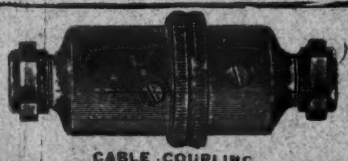

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